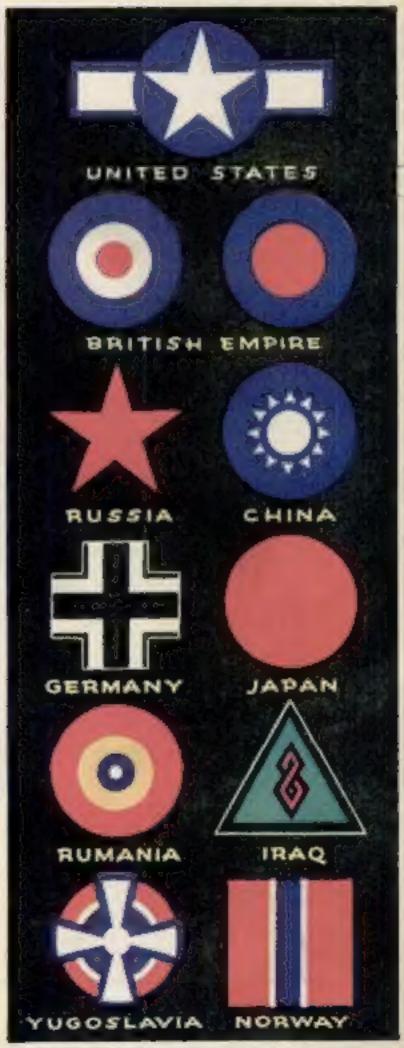
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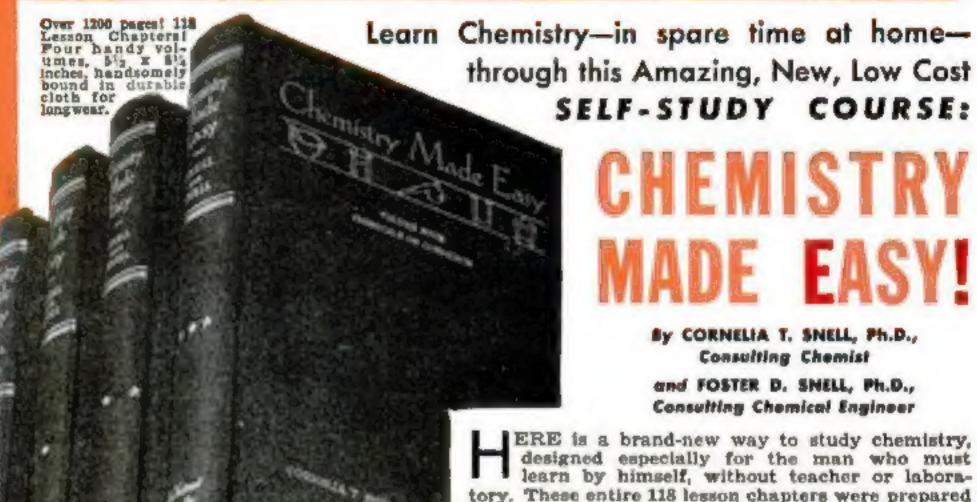
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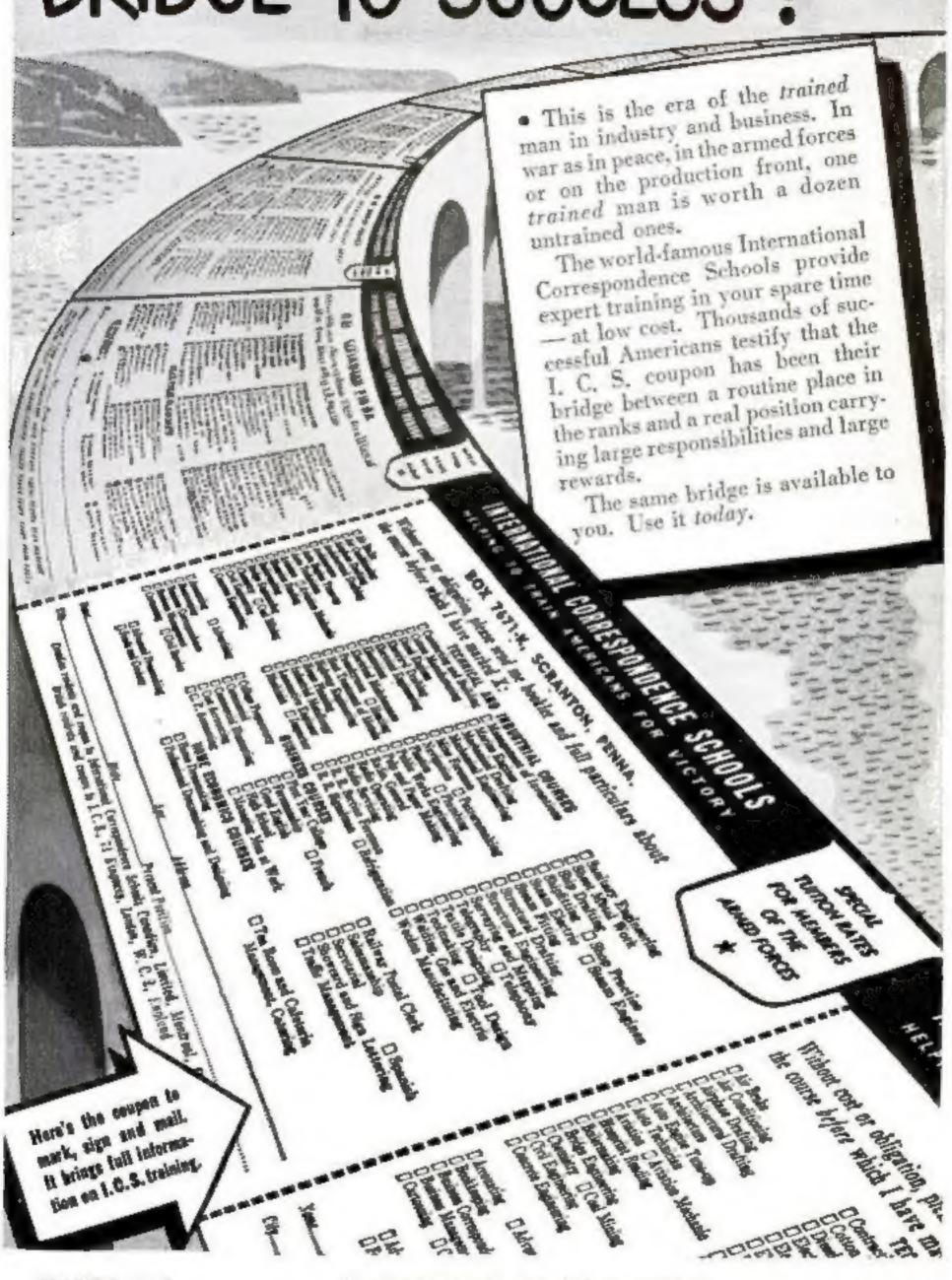
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Mechanics & Handicraft

A TECHNICAL JOURNAL OF SCIENCE AND INDUSTRY

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P.S.M. GOES TO THE FRONT. Representing Popular Science in the European war theater is this able reporting team; Hickman Powell, writer (at right, above), and Harold Kulick, photographer. Their first exclusive war-front story, "The Kite That Smashed Berlin," appears in this issue. Powell's pen and Kulick's camera will bring our readers first-hand reports of history-making events as the European campaign moves toward its victorious climax.

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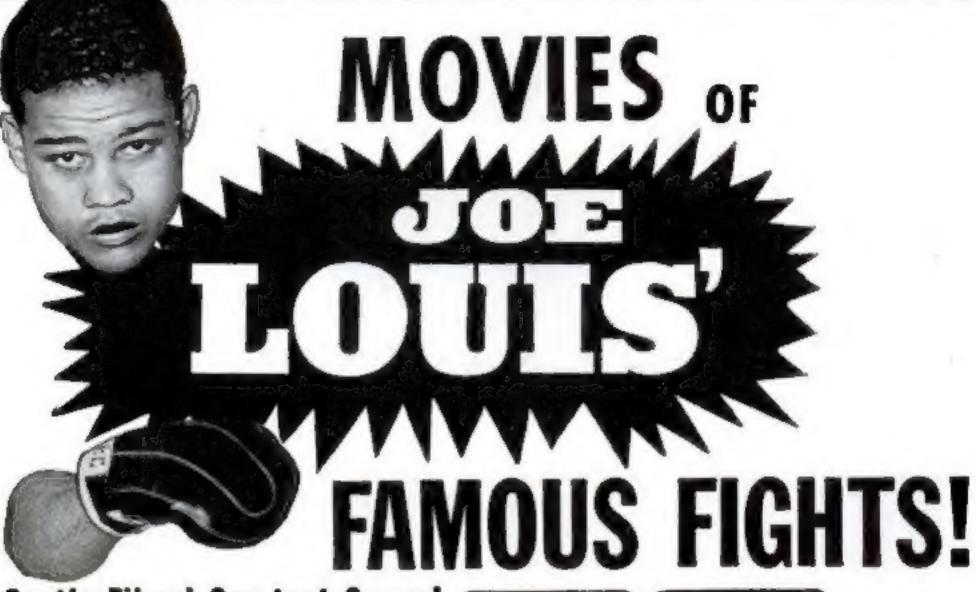
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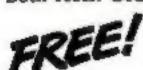
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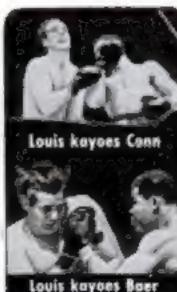


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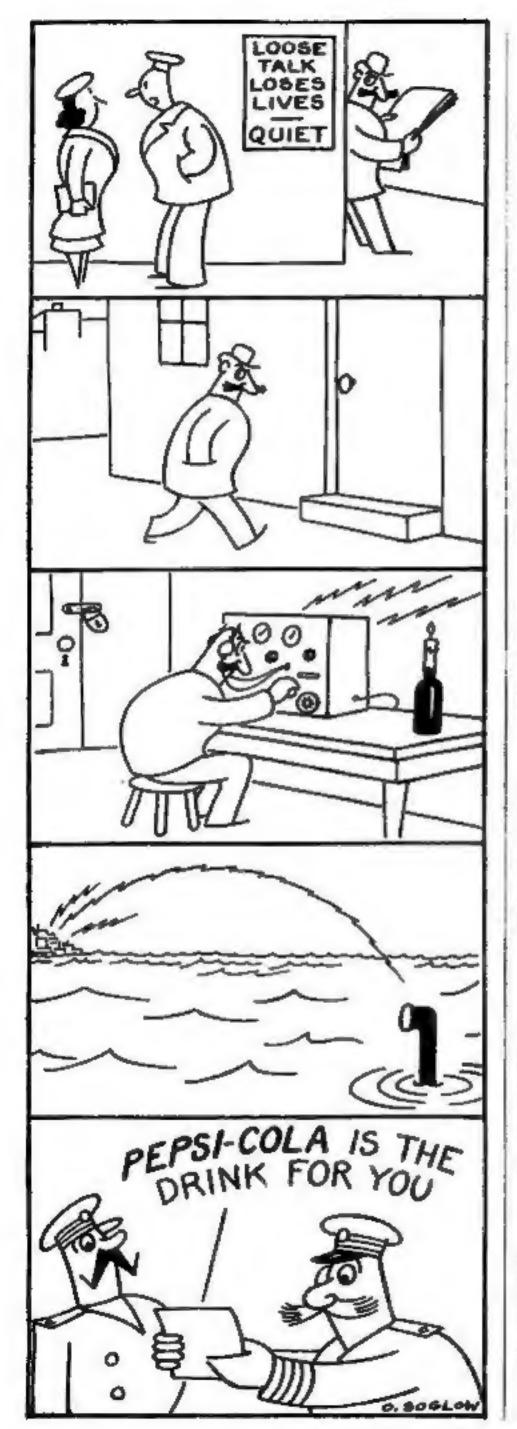
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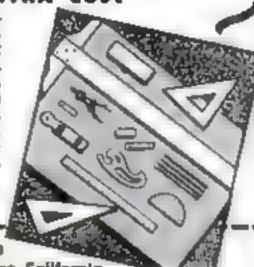


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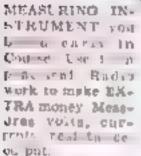
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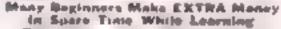
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But later I discovered the secret that turned me into "The World's Most Perfectly Developed Man." And now I'd like to prove to you that the same system can make a NEW MAN of YOU!

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I don't care how old or young you are or how nehamed of your present physical condition you may be If you can simply raise your arm and siek it. I can add SOLID MUSCLE to your biceps—) rs. on each arm—in double-quick time! Only 15 minutes a day-right in your own home-is all the time I sak of you! And there's no cost if I fail.

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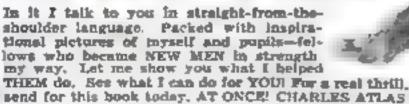
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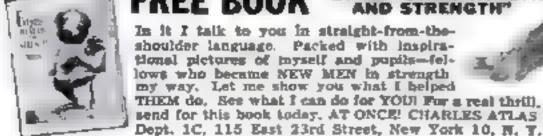
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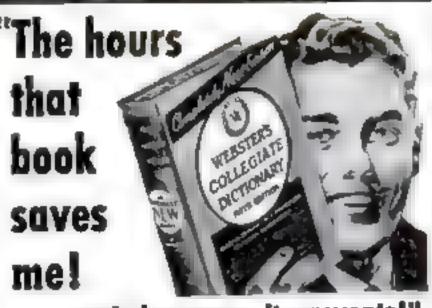
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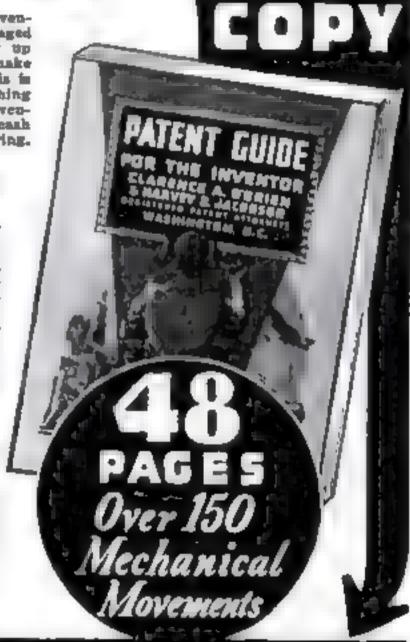
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- - (Please write or print plainly,) --



The recent photograph that a reader found we had "scooped" with the picture below, which appeared in our June 1942 issue. See the following letter



Seems We've Gone and Done It Again

I've got to hand it to you, P.S.M.! It seems that I am constantly reading articles on subjects that you have covered months before, or seeing pictures that you have published long in advance of other periodicals. Well, you've gone and done it again. Just the other day I saw a photograph of an American captain examining a charge of TNT that the Nazis had strapped to a tree trunk preparatory to knocking it down in



the path of our troops advancing in Italy. Well, exactly 18 months ago you published a very similar picture showing demolition engineers of the U.S. Army preparing to knock over a tree in practically the same manner. Congratulations, and keep up those "scoops." —D. R., New York, N. Y.

Was It Gus Wilson, or Handleless Tableware?

DEAR "Pop": What a mag! You've got it! Being a busy war worker and also a home owner, I have practically no time to read. anything in my spare time. To make up for that, I pack P.S.M. off to work and read it during my half-hour lunch period—and almost forget to eat! I have a problem I would like some advice on. I purchased a set of stainless steel tablewars-knives, forks, and spoons—with colored plastic handles. Now several of the handles have split or broken off entirely. My problem is to put new handles on these implements, for stainless steel is not to be thrown away in this day and age. And one more thing. Don't let Gus Wilson go off on any more vacations. His absence from the last issue just about gave me indigestion.—G. R. C., Norfolk, Va.

Help Before He Breaks His E String

While cleaning the floor a few days ago, I took the hose off the vacuum cleaner and started to sing through it. When I howled in

an ever-rising or lowering voice, the tube
seemed to break the
sound up into distinct
parts. Yet when I took
the hose away from
my mouth, my voice
sounded perfectly natural. Will some kind
person explain this
strange phenomenon
to me before I break
my vocal cords experi-



menting?-S. S., Detroit, Mich.

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172-grain ammunition, which is 22 grains heavier than battle ammunition. Anytime in practice or competition where we had a choice, we chose the 172-grain ammunition, because in addition to being heavier it was also "boat-tailed" (the word "streamlined" hadn't been coined yet). This ammunition proved too accurate to



leave any doubt about its advantage over the flat-back builets. I know little about the laws of physics, but if they teach us that we would have a faulty resolution of forces by streamlining a projectile, they must not have considered that a builet being streamlined has more area for the charge to press against. Surely the advantage of streamlining a projectile more than offsets the disadvantages which you set forth in December Readers Say. I am for S. E. W. 100 percent.—H. T. W., Chicago, Ill.

Now He Knows What He Is Singing About

I have wondered for years about those lines in "The Star Spangled Banner" that read "the rockets' red glare, the bombs bursting in air" In your December issue, the article on the bazooka states that the Congreve artillery rocket was invented about 1800, and was used by the British against Fort McHenry in Baltimora Harbor. In the article on the evolution of naval guns, however, you put the invention of explosive shells at 1822. Will you please tell me what were the "bombs" that are mentioned in our national anthem?—F. J. R., New York, N. Y.

Hollow shot filled with explosive or incendiary mixtures, and thrown from mortars, were used as far back as the sixteenth century. It was probably projectiles of this kind that Francis Scott Key saw and described as bombs."—Ed.

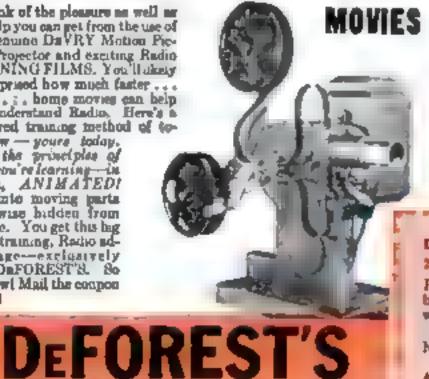


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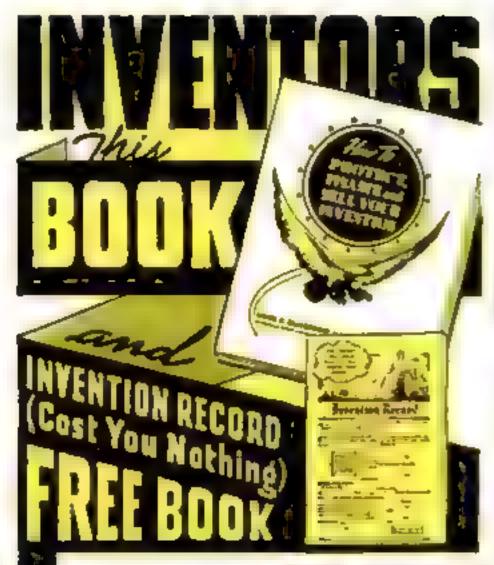
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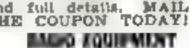


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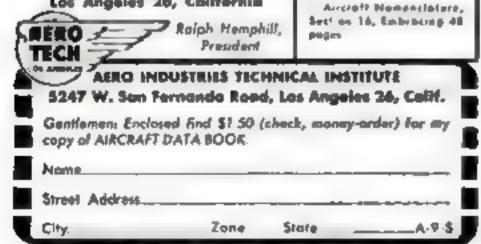
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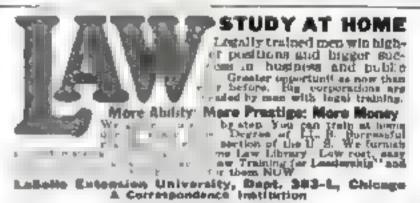




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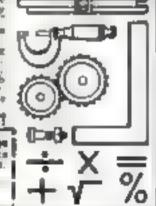
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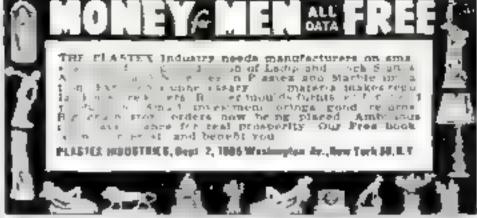
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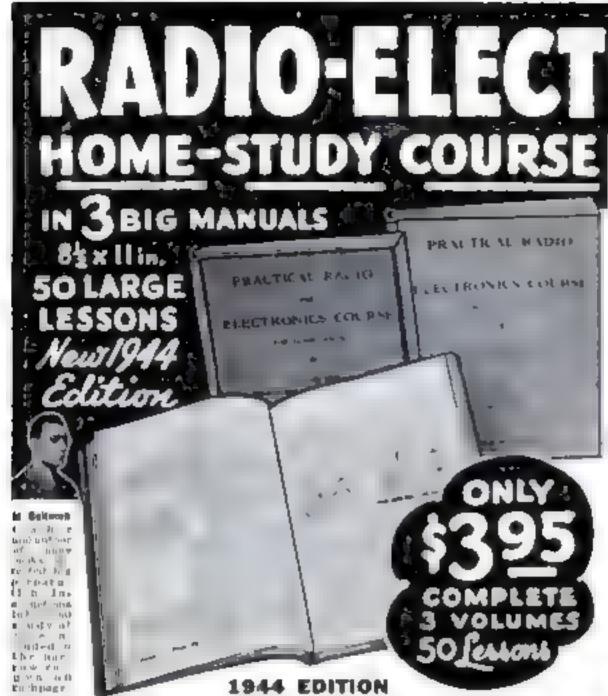
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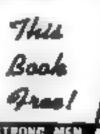
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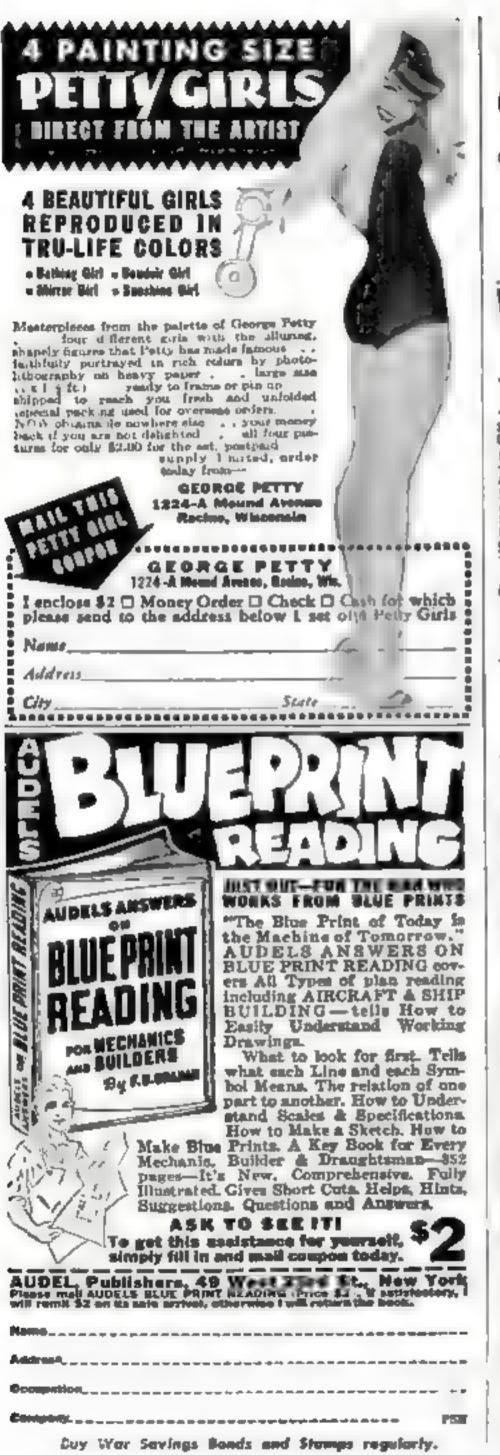
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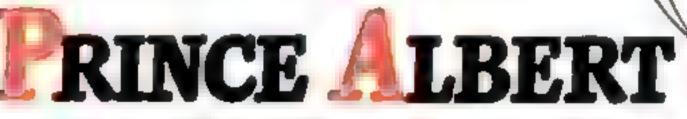
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The lads who fly Britain's big Lancaster bomber love her like a sweetheart. This tale of her exploits will show you why.

THIS is the story of a lovely kite which, with the help of a mickey mouse and a cookie and a lot of soft-spoken young lads with tin whistles pinned to their jacket collars, has been blasting the cities of Germany into wreckage and flames—the most wholesale, ruthless job of destructive warfare in history.

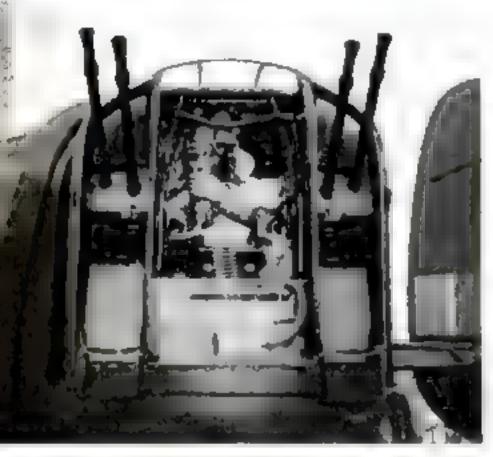
This kite was bred and born in the blitz which sought to destroy England, the first great aircraft to grow out of this war's actual experience. She is now just coming three years old. She is big and she is heavy—30 tons, no less—but any of the RAF lads who fly in her will (Continued on page 48D)



Unlike most Lancasters, this kite has an individual name. The Texas Tornado was so christened in honor of its skipper, Pilot Officer William Turnbull, who is one of those Canadians hailing from San Antonio



Grim reminders of what may lie ahead are the cable cutters set into the leading edge of the Lanc's wing. A barrage-balloon wire sliding into one of the protruding hooks will be snipped through by a sliding blade



Deadliest part of the kite's defensive armament is the tail turret, with four .303 caliber machine guns firing 1,150 rounds a minute each. Ammunition is fed by power tracks from amidships, lightening tail

Seven youngsters mon the ship' pilot, bomb-aimer, navigator, engineer, radio man, mid-upper gunner, and tail gunner. The five last named are sergeants

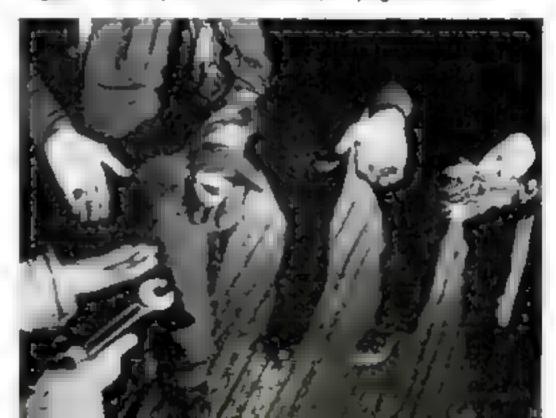


Mid-upper turret guns have guards with wheels that roll over the fuselage, keeping the guns from depressing so far as to shoot off the tail or cackpit. The Lanc carries a total of ten .303's, mounted in four turrets

For good luck, the tail gunner carries a spanner; Tex, a lucky forthing; upper gunner, a pair of tay boots; engineer, a tiddlywink; bomb-aimer, a sprig of heather

THE CREW







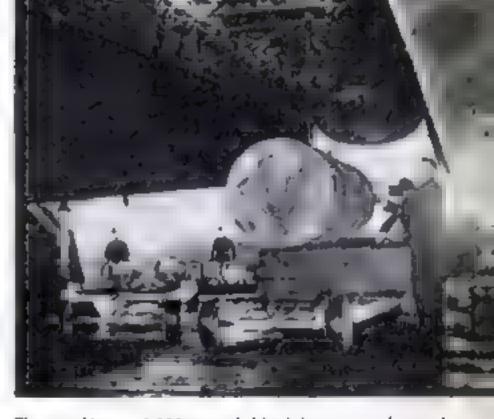
Before a trip to Berlin, the ground crew works all day over the four 1 175-horsepower Rolls-Rayce Merlin engines. The Lanc's three-biaded propellers are 13 feet in diameter and full feathering to prevent windmining



In the afternoon a tractor-drawn train of trallays winds around the perimeter track and into the bay. It brings the 4 000-pound block-buster and assorted smaller bambs that the Lanc will houl to Goering.



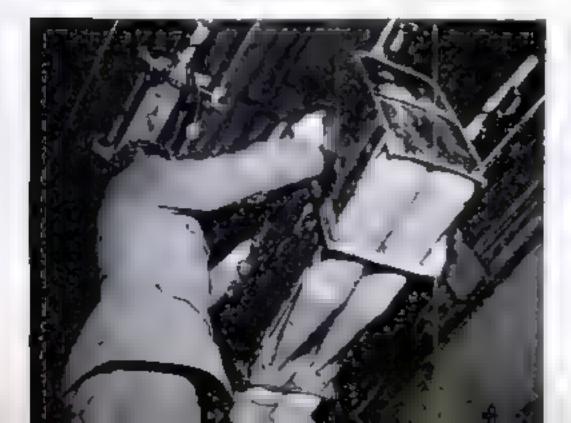
Here the electrical bamb release is being fitted to a 500-pound bamb. Unless the bamb bay doors are open the release will not work. Drapping the whole bamb load in proper order is the job of the automatic mickey mayse.



The cookie a 4,000-pound black-buster, is hoisted into the covernous, 33-foot-long bomb bay. Not a streamlined miss le, it looks more like a 300-ga lon water tank. One end is empty for nase-down fall

Thirty-pound incendiaries, packed 16 to a can, will be released by tripping the bar on the battom. The rest of the load is in four-pound incendiaries. 150 to the can

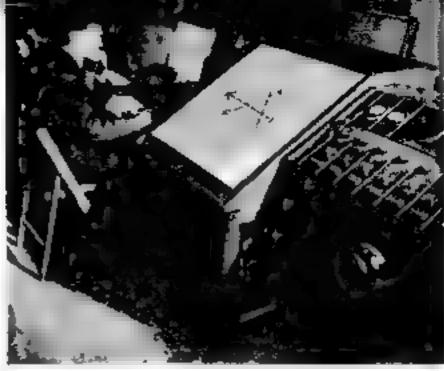
Briefing is serious business. After getting the route from the operations chief. Tex charts the course with his crew. Routes vary night to night







After a final word from the Group Captain and the Wing Commander, Tex and his crew ride out onto the field in a truck and climb into the big Lanc. They have been flying together now for more than a year



From the control tower, a talker gives instructions on which runway to use. A lighted diagram in the tower shows the runways and the perimeter track. A plane leaves the field every two minutes

tell you she is as sweet and dainty a filly as ever whirled around in a vertical turn.

We are talking about the Lanc, the Avro Lancaster four-engined bomber. This is the aircraft which, more than any other, destroyed Hamburg, burned up and flooded the Ruhr. This winter she has gone night after night in mass concentration to pour explosive fire on Berlin. This is the British aircraft whose mass production made it possible to deliver 2,300 tons of explosives and incendiaries in a half hour on a single point of German war production; and that, as everyone must agree with the men of the RAF, is a thoroughly good prang. A very devastating creature she is, this avenging black lady in the dark,

Maybe you have thought of her as a drudging pack horse or a flying boxcar, with that eight-ton load in her yawning belly. Maybe she looks a bit nose-heavy to you, with her jutting engines and fuselage. But you would not care to express such notions to any of the lads who take her out at night. They love her like a sweetheart, partly because she handles so gently, and partly because they have come home together, quietly and safely, so many times.

One of the first things you learn about the Lanc is the emotional regard her men have for her. Later you learn that this is based on sound engineering fact.

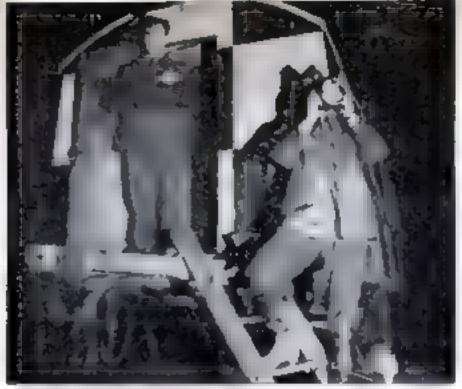
There is an almost mythological quality about the way in which—during the white heat which followed the black summer of 1940—the Lancaster sprang full-blown from the brow (and 30 years' experience) of her creator, Roy Chadwick, chief designer of A. V. Roe & Co. There she was, practically perfect for her purpose, the night bombing of Germany. They have never taken any bugs out of her, to speak of, because she had none.

The Lanc which is now bombing Berlin is virtually the same aircraft as the Lanc whose original prototype first appeared in January 1941 and which was in production and in combat a year later. The only important difference is that many of the Lancs now being built are powered with the American-made Packard version of the Rolls-Royce Merlin XX engine. A great weight of the bombs dumped on Berlin has been carried there by this Packard power.

Engines have been improved much during the last three years, but the Lancaster's power has not been increased and it will not be. That is because, in designing her wing, working under pressure and at the highest speed ever attempted in building a major airplane, Chadwick achieved a remarkable feat—a perfect blend between power and airfoil. The most efficient speed of the Lancaster's wing is precisely the same as the most efficient speed of her engines. If it ever seems advisable to increase her power, it will be necessary to redesign her airframe to maintain her performance.

Because of its Bendix carburetor, the Packard Merlin has somewhat more lifting power on take-off than its English counterpart, but in the air its performance is precisely the same. Each of the four engines develops 1,175 horsepower at 21,000 feet, with the supercharger operating at top speed,

The Lancaster is the drastic modification of a relatively unsuccessful aircraft, the Avro Manchester, which resulted from a bad bet the British made in the prewar years. They then planned a fleet of heavy bombers, each to be powered by two unusually large engines. Designed for the purpose was the Rolls-Royce Vulture, which was two V engines built together in X form, with 24 cylinders on one crankshaft,



Ground men stationed at a trailer down the runway flosh a signal to give the Texas Tornada the green light. From now on, the Lanc and her men will be strictly on their own

Off to Berlin. The Lanc flies alone, not in formation. Precisely an schedule it must rendezvous above the target with nearly 1,000 other attacking planes. In bombing, the planes fly at different levels to reduce the risk of collision and danger from the Nazi flat



developing 1,710 horsepower. The Vulture had teething troubles (it was clumsy, for instance, to build four connecting rods into a crankshaft bearing where two made a very pretty job). The Vulture had production troubles. And though all these were eventually overcome, Rolls-Royce does not believe in oversized engines, and is happy today not to be producing the Vulture any more but to be concentrating on the production of ever-increasing miracles from the Merlin.

The Air Ministry hedged its bet on the Vulture. In the blueprint stage the Halifax was changed from a two-engine bomber to a ship carrying four Merlins. But the Manchester, completed with two engines, turned out to be not so hot. Not only was the Vulture difficult to produce and maintain; 24 cylinders made too many eggs in one basket. If one engine was hit or conked out on take-off, it was a lopsided load to balance quickly. Through the first year of the war there was talk of rebuilding the Manchester, but the many committees and boards made no decision.

Then came the summer of 1940. After the fall of France, with Britain's back to the wall, there came a violent upsurge in fighting spirit. At the Avro factory, ignoring red tape, financial support, and all other formalities, the managing director, R. H. Dobson, and the designer, Chadwick, plunged their organization into the building of a four-engine Manchester. Ordinarily the con-

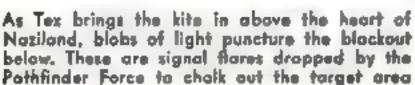
struction of a prototype aircraft takes years, but on this one all records were broken. She never went through any proper blue-print stage at all. Some of her drawings were made from the parts themselves as they were hurriedly fabricated and put together into the original prototype of the Lancaster. It was hardly six months before she was flying, and the first tests quickly showed that this was it.

In appearance she was much the same as the Manchester, a midwing cantilever monoplane with twin oval tail fins and rudders. She was about the same length, a trifle over 69 feet, 20 feet high. Her wing span had been increased 12 feet to 102 feet. But with an increase of hardly more than 25 percent in power and 15 percent in wing surface, her bomb load had been nearly doubled and her speed raised to 300 miles an hour.

And she handled so sweetly that a man flying her felt as if he were throwing a fighter around. This quick adaptability to evasive action, together with the load her 33-foot bomb bay could carry, made her a natural for night bombing; but her first exploits, early in 1942, were daylight hedge-bopping raids on Germany and Italy.

Her armament was hardly heavy enough for this, though she bristled with 10 Browning .303 caliber guns in four turrets—nose, tail, upper-middle, and belly. Lanc gunners find the light caliber quite adequate for their purpose, since in a night battle they never get a shot at more than 800 yards and usual-







in the astral dome behind the pilat's canapy, the fighting controller looks out for night fighters. The flores have shown the Germans where the bombing run will be. Nazis drop parachute flores from above

ly are working at 500 yards or less, and since the gun has extremely high rapidity. The tail turret is a real stinger, with four guns fed from magazines amidships by four power-operated tracks. When these guns are going, each at the rate of 1,150 rounds a minute, a night fighter is not eager to press a rear attack.

Such is the Lanc. She is a simple, austere aircraft. Her men are proud to say she has no gadgets save what are essential for getting the bombs to the target and bringing the crew back. Her simplicity of structure adapted her well to mass production. She is built in units, at factories scattered all over Britain for protection against bombing; then the units are brought together for assembly. That production has grown until now Lancasters alone can go by the hundreds to blacken the flare-lit skies of Germany.

But for all the mass, the personality of the Lanc shines through, not only as a type but as an individual. The British do not often give their aircraft individual names. as the Fort men do, but the Lanc has the power of imparting individuality even to the alphabetical names which are common to the kites of every squadron—such as E-Easy, F-Freddie, T-Tommy—not "F-for-Freddie" as so often printed.

This article, indeed, was meant to be the tale of a young American who loved a Lanc called S-Sugar. It would have been a rather different story, for the way of a man with a machine is a wondrous thing, differing with the men of every nation, and the Yanka have a way all their own.

First Lieutenant E. G. Roberts was his name, of Merchantville, N. J., and the U. S. Army Air Force, on detached duty with the RAF. When they washed Roberts out as a pilot in the States, he said nuts to being grounded, and somehow wangled himself a job as the captain of a Lanc. A color photograph of him would have made a striking symbol of Anglo-American kindred. In the midst of his boyish blond face was one of those English puffball mustaches, recently

ACK HOME These are tense hours

Waaf talker waits anxiously for the crackling voice that will report first arrival Out on the field, marker searchlights and flare path guide the returning bombers. Tex identifies his aerodrome, among the many in the neighborhood, by an initial letter in electric lights. In fag, some planes may land on other fields







Fires, flares, tracers, and flok cover the stricken city with a weird pyrotechnic pattern. Great orange-colored spots blossom where the cookies hit Sister Lance flying at lower levels glide across the glare as ghostly silhouettes. With bomb bay empty, the kite turns for home, leaving the flaming city astern

As soon as they land, Tex and his crew go for questioning by intelligence officers, who piece together the scraps of information to determine the results of the raid. At other tables, the other crews are interrogated A cup of tea helps ease the tension of men just back from hell. Because they crossed the "egg line" tonight, each man gets a fresh egg (priceless in Britain) for his breakfast





cultivated. He was wearing a battered drab American officer's cap, all pushed out of shape by his earphones. On one breast he had British wings and on the other American. And on the shoulders of his blue British tunic, which the RAF wear without insignia, he had his American lieutenant's bars. Altogether a fine, careless, debonair, and dashing boy. We were going to get his story, but he didn't keep the appointment.

"Roberta? Oh yes. Fine chap," said the Adjutant. "He went, you know. Three nights

ago. To Stuttgart."

That much belongs here anyway. For it is through happenings such as this—that the fine chap you had a drink with last week isn't here today—that a man on the ground can feel the utter reality of this curiously clean-shaven, well-mannered, almost whimsical war the British are fighting. They have picked themselves up out of the grime and rubble of their own blitz, dusted off their well-worn clothes, had a bathe; and now they are proceeding in a suave and quiet way to blow Jerry to bits.

The extreme youth of most of the participants in the far-off battle is accentuated by such things as the toylike whistles pinned to their collars—carried for the grim purpose of helping them find each other in the dark waters, should their Lanc be ditched

in the Channel.

It is always slight things that reveal the grimness—such as the glint of cold bate in the choir-boy face of a bomb-aimer, when he tells you how good it feels to press the button of his mickey mouse and let go his cookie over Berlin.

и

You call it a block-buster, because the newspapers named it that. But none of the lads in the RAF would ever call it anything but a cookie. A cookie in England is not something to eat. It is a 4,000 or 8,000-

pound bomb.

A cookie is as innocent-looking as a bombnimer. Never in all history, probably, has a violent instrument of destruction appeared so prosale. An American 4,000-pounder has a round, pugnacious nose and jutting fins. A 4,000-pound cookie has the appearance of a 300-gallon water tank, too cheaply built to withstand pressure. It is a light steel shell, eight feet nine inches long and 30 inches in diameter. Inspection shows that one end of it is just a hollow shell, whose light weight acts in lieu of fins, as a tail to keep the nose turned downward. But that heavy nose packs a wallop of high explosive.

A cookie is capable of innocent tricks. I know of a man who was standing only a few yards from a Lanc once when its cookie exploded. The Lanc disintegrated completely, in an orange flare which leaped to heaven. The man was knocked down and lost his hearing for two days. He had happened to be caught in a sort of eddy, immune from the full force of the explosion.

A cookie in exploding makes little crater but blows a great hole in the atmosphere, a vacuum which suddenly draws in and sucks the finsides out of everything within hundreds of yards. Block-buster is a diminutive misnomer for a thing with this cyclonic area of destruction.

In bombing up a Lanc, the cookie is hauled up first into the middle of the bomb bay, which dwarfs it with its cavernous extent. Unlike the Fort, whose deep bay runs up to the top of the fuselage, the Lanc has a broad expanse which, though relatively shallow, covers half its belly, with a length of 33 and a width of more than five feet. This is filled—every crack and cranny around the cookie—with incendiary bombs which, glittering with brass, green, and red, make the loaded bomb bay look like a great big box of Christmas candy, with a chunky licorice stick in the middle.

The greater part of the incendiaries are of four-pound weight, carried in canisters, sheet-metal cans without bottoms, in which the close-packed bombs are held by rods which can be tripped by the automatic bomb release, affectionately known as the mickey mouse. The bombs are hexagonal, 20 inches by 1.5 inch across.

These incendiaries are bulky for their weight, of course, but last summer when it was decided to burn up the Ruhr their number was increased to a fantastic extent. The cans were deepened from a capacity of 60 to 90 and then to 150 incendiaries each, carried in three sections, fitted honeycomb fashion, five wide and 10 deep. These cans are now so deep, in fact, that their corners sometimes wear holes in the inner surfaces of the bomb-bay doors.

According to their objective, bomb loads differ in their extent, but let us calculate a not unlikely load of, say, about six and a half tons. The cookie makes one quarter of this. Ten cans of four-pounders weigh 6,000 pounds—1,500 white-hot flares of candescence. Then let us add six cans of 30-pound oil-type incendiaries—96 big flames.

The incendraries, of course, are varied in their content, to complicate the task of fire fighters. The 30-pound bombs contain phosphorus, which burns the harder when water

is put on.

All these bombs are dropped in a calculated pattern, effected by the mickey mouse. First goes a photographic flare, so that the automatic camera carried in the plane can record the target (Continued on page 200)



Climb into the Cockpit

with a Navy Scout Pilot on "Night Recon"

You are invited to go along on a "routine" flight that holds a whole lifetime of thrills.

By GEORGE POLK

Lieutenant, U.S.N.R.

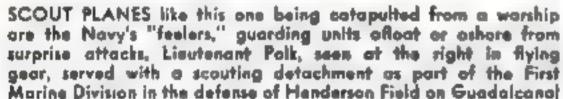
You'll be flying a seaplane scout on reconnaissance in the combat sector patrolled by your squadron.

Your primary responsibility is that of protecting our shipping and newly won shore base from a surprise night attack by enemy surface raiders—despite the possible attempts of enemy night fighters to rid the

air of your sharp eyes and blatting radio. For more than a week now, since shortly after American forces raced ashore to capture this port from the enemy, you and your squadron mates have flown nightly, searching up and down the coast and out to sea. The planes have been in the air in spite of bad weather, enemy opposition, and the hazards of night take-offs and landings without lights.

Just at sunset, at the shack built by the enemy for an officers' club (they left excellent beer behind in their basty departure!), Air Operations and Intelligence officers carefully outlined the flight for you. Your special radio call was assigned; the base was given a radio name. The night's radio jargon and plans of action were agreed upon. The anticipated movements of our warships and merchant ships cruis-







ing just outside the harbor were explained.

In the words of the Air Operations officer: "Bud, anything you see out in your search sector is the enemy, so don't waste any time giving us the word!"

For an hour you've been on edge to get going. It's always that way before a hop.

Now, as you walk to your plane in the fading twilight, you mentally check your personal equipment for the hop; heavy socks and shoes (you might have to walk home some night); dungares trousers, heavy shirt, light flying jacket (it won't be very cold "upstairs"); .45 automatic (shell in chamber, ready for use) in shoulder holster, extra clip of shells (tracers, so that they can be utilized for emergency signaling); six-inch sheath knife (handy for cutting away shroud lines in the event of a parachute landing in the sea); tiny sealed tine of quinine, sait tablets (to prevent heat exhaustion), aspirin, sulfanilamide (for powdering on burns and wounds), sulfathiazole (two tablets every four hours if burned or wounded). Helmet, goggles, rubber life jacket, and navigation chart board complete your gear.

And here, lying alongside a makeshift dock in the water, is your plane.

"Howdy, Stedman. About set?" (Stedman is your back-seat radiomen-gurner) "Yes, sir. I'm ready and so's the radio,"

Before the last of the twilight is gone there is time to make a quick check of the plane. First, the parachute flares suspended under the wings in the bomb racks. Give them a jiggle to see that they are hung securely. Both look "4.0" (Navy slang for perfect).

As you climb up the wing to your cockpit just behind the engine, you pause to inspect the compartment a little below your seat. Here is stowed the deflated rubber boat that you and Stedman hope you'll never have to inflate. Attached to this boat is a long string of provisions, each a tin of food sewed to a light rope. Hooked into this line are three canteens of water. Boat, food, and water can be jerked from the plane in an instant.

Now, a leg up and over, a couple of squirms to settle yourself in the seat on top of the parachute; your hands and feet work the stick back and forth, the rudder from side to side. The controls feel smooth.

Reaching down carefully with your right hand, you touch the additional flares that are just to the side and under your bucket seat. These are ready to be popped out a little trapdoor in the side. Then to the fuel system. A tug on the gasoline-tank plunger sends the pressure up on the lines; the fuel-gauge needle flicks around to the "full" marker. You turn from the plunger to the maze of switches on the panel just above the rudder controls—gun-sight illuminator, landing light, running lights, cockpit lights, anchor lights. Time to plug your earphones into the radio connection. With the radio

switch on "ICS" (intercockpit communication system), you speak into the mike.

"How does it sound, Stedman?"

"Sounds fine, sir. Ready back here."

Your left hand moves the mixture control to "Full Rich." You pump the throttle back and forth rapidly several times, leaving it open slightly. A nod to the mechanic on the wing. He inserts the crank into the inertia starter, high on the left side of the nose. You reach forward, low and to the left, turning the gasoline tank selector from "Off" to "Main," at the same time glancing at the ignition switch to be certain that it is "Off." Your left hand falls back on the wobble pump just below the throttle quadrant; your right releases the primer pump, and as the wobble builds up pressure in the gas lines you prime the engine with three quick shots. The crew chief gives a loud "Clear" (all clear of the prop). The starter begins its whine, becomes shrill.

"Contact."

"Contact." On with the ignition switch to "Both" magnetos. A hard pull to engage the starter. A loud cough. The engine catches. The throttle smooths its protesting, spitting rumble. The mechanic drops off the wing; the beach crew lets the tail swing free. You're on your own. Good luck and good hunting!

As you taxt out into the dark harbor, your eyes sweep the board, checking each instrument. Oil pressure O.K. Oil heat and cylinder-head temperatures climbing

toward normal. R.p.m. steady.

You pull your 'chute straps over your shoulders but do not fasten the leg or chest buckles. (In case of a crack-up on the take-off a strapped-on 'chute would slow a

prompt exit from the cockpit.) Snap the safety belt closed and rock forward against it to see that it's tight and buckled. A careful last look around; you can't see anything except the dim outline of a darkened shore, but you're out in the take-off area.

Stedman anticipates your question with an "All set." (He is riding face forward for the take-off. As soon as the plane is well in the air, he will reverse his position in the rear cockpit, pull on his 'chute, snap his safety belt on in reverse position, break out his rear guns.)

You turn the plane onto the compass course for take-off. (A silent prayer that no wreckage or small boats are in the course.) Full gun—throttle wide open. Back and forth, hard and fast, goes the stick, pumping the scout's ponton up on its hydroplane step. The plane bucks and bobs. You rudder hard to hold compass course. Faster and faster. And up on the step she goes.

Throttle wide open, you change hands on the stick. Your left goes to the stick to hold the plane on the step, your right to the flap-control handle just below the level of the seat, next to the flares. Three short strokes and the flaps are cracked down about 15 degrees. That will get the plane into the air at a slower take-off speed. Your eyes never leave the compass.

"Up, baby, up."

Up she goes. Level off to pick up a little extra speed, then back easy for a gradual climb. Watch 'em close—needle, ball, air speed—make it a perfect take-off by instruments. Ease the throttle to cruising, the flaps to neutral. Get into your 'chute harness. 'The recon's on its way.

Five minutes (Continued on page 195)

THIS IS THE PERSONAL EQUIPMENT YOU TAKE WITH YOU

1. Web belt, 2. Parachuta pack. 3. First-aid pack. 4. Pouches to hold first-aid pack and small tins of medical supplies, 6. Sulfanilamide for powdering on burns and wounds, 6. Sulfathiazole. 7. Quinine. 8. Aspirin. Salt tablets to prevent heat exhaustion, 10. Flying helmet and goggles. 11. Extra clip of pictol ammunition (tracers for signaling). 12, Shoulder pistol holster with pocket for extra ummunition. 13. Automatic pistol (.45 coluber) with shell in chamber ready for use. 14, Six-inch shouth knife for cutting parachute shrouds if you fall in the sea. 15. Navigation chart and board. 16. "Mae West" water jacket



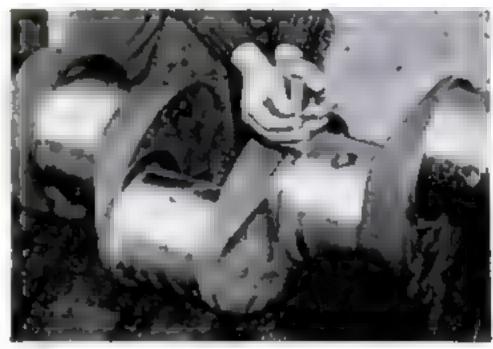


DLASTING with dynamite saves valuable orankshafts from the scrap pile at the plant of the Ohio Crankshaft Co., of Cleveland. When oil holes are drilled in the bearing surfaces of the crankshafts, bits frequently break off and remain jammed in the holes. Formerly, this usually meant the scrapping of an expensive, precision-built shaft. But Nels Sorenson, superintendent of the Automotive Crankshaft Division of the company, got an idea when he saw a farmer dynamiting tree stumps. The result is the effective procedure illustrated on this page. It can also be used on dies and fix-

A collection of dynamited drills. Large lumps are places of a big care drill. While one charge usually is enough to free a small drill, as many as 72 blasts may be required to disladge a large one

tures in which drills, plug gauges, and reamers have been broken off. Clean holes

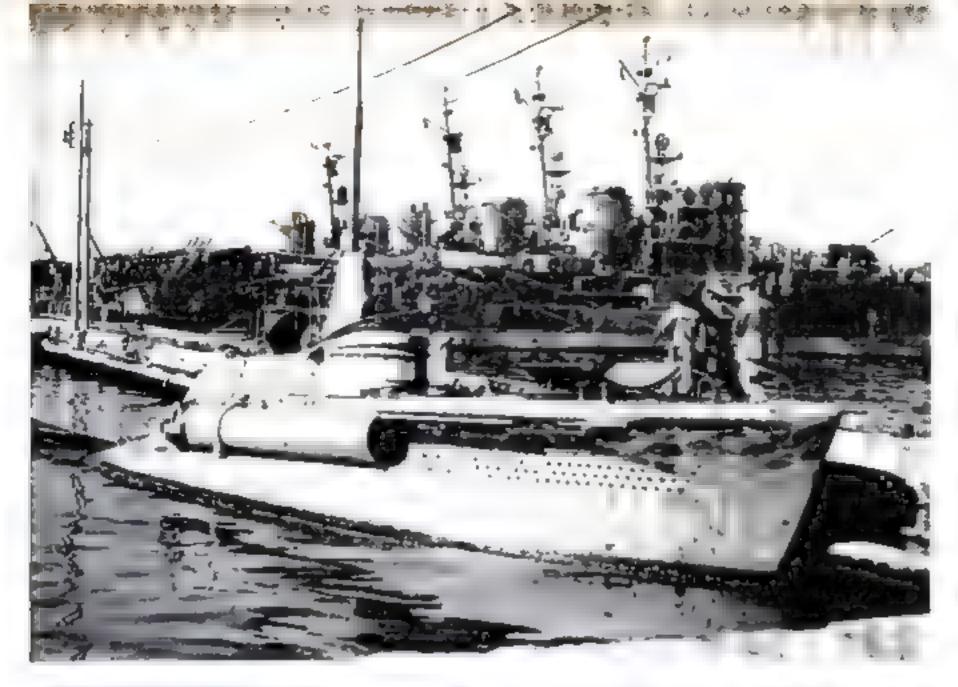
are left, with no damage to the part.



After wire probe has revealed position of drill, a thimbleful or less of powder is poured in, cap is inserted, and the fuse ignited. Below, a drill blown out of a shaft split a four-by-four timber placed over the charge to check the flying pieces







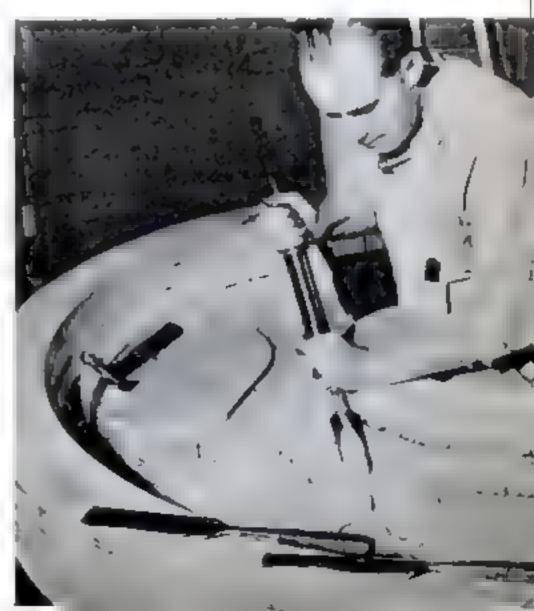
THIS MIDGET SUBMARINE was among the powerful units of the Italian fleet that fell into the hands of the Allies. Shown moored in the harbor of Taranto before being trans-

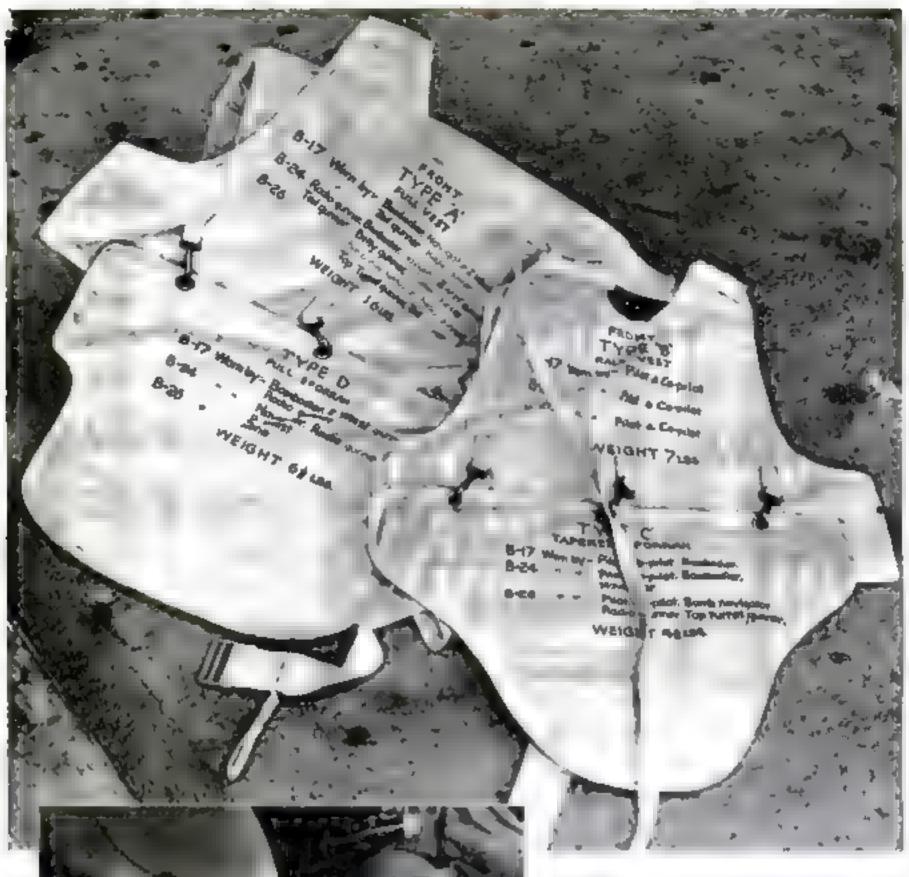
ferred to Malta, the strange craft looks like a motor torpedo boat. Note the curious manner in which its torpedo tubes are attached to the outside of the hull.



THE LIBERATOR, biggest diamond yet found in Venezuela, was recently air-mailed from Caracas for 40 cents and purchased for \$200,000 by Harry Winston, Inc., New York jewelers. Named in memory of Simon Bolivar, the nearly flawless stone weighs 155 carats. Sixty-five or 70 gems the size of that seen in the ring above could be cut from the Liberator, but it will be more profitable to cut five or six huge jewels. Venezuela promises to develop into a leading diamond source.

COMPRESSED-AIR carving tools speed warproduction work in foundries and pattern shops, according to the Compressed Air Institute. Operated by hand, as shown below, they do both light and heavy routing, carving, logging, and chiseling.





"Flak Jackets" Now Marked

CTEEL-AND-CANVAS "flak jackdets" that protect our flyers from enemy bullets and steel fragments (P.S.M., Oct. '43, p. 108) now carry printed instructions to show which parts of the jackets are to be worn by each crew member of a B-17, B-24, or B-26 bomber. Pilots and copilots wear only the type B front half vest and tapered sporran (apron), as their backs are protected by the planes' armor. Other members of the crew, however, who have to move about in unprotected areas, wear either the full or tapered apron and also the full vest, which protects the chest and back. Developed in England, the jackets have materially reduced injuries.

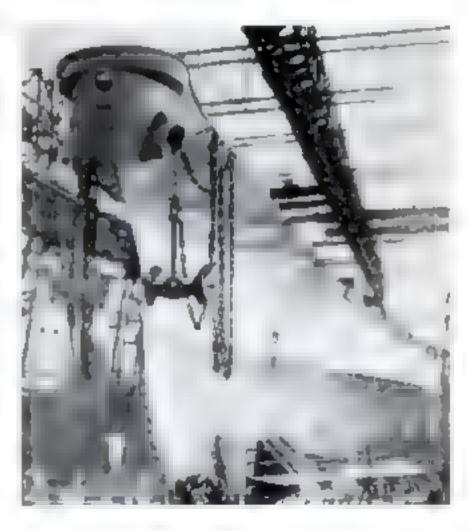


TO REPEL low-flying bombers intent on hitand-run raids on coastal objectives, the British have dotted their countryside with elevated gun positions which give spotters an unobstructed view of ground and sky so that hedge-hopping planes can't slip by, and offer the Bofors guns a clear field of fire. Self-sufficient, these flak towers house their own generators and ammunition. Crews on 24-hour duty live in near-by huts.



DEMOLISHED by a shell from an American warship, this pillbox on the beach at Tarawa shows the sturdy construction of the Japanese defenses cracked by the U.S. Marines in the Gilbert Islands. Supplementing the large concrete blockhouses inland, armorplated pillboxes like this were set near the shore and camouflaged with sand embankments and fronds from palm trees.

BIGGEST BATTLE WAGON. Launched December 7, the new battleship Wisconsin Will displace 52,000 tons when armed and manned. She is believed to be even more powerful than the mighty New Jersey.



MARCH, 1944

Īce-Age "Zoo" Lives

California tar pits furnish models for life-size statues of our prehistoric animals.

N OUTDOOR "zoo" stocked with sculp-A tures of prehistoric monsters has been set up at La Brea, Calif. The site is appropriate, since centuries ago, when glaciers moved down the North American continent, animals hunted and fought around the tar pits in this region. Lured to the edge of the "black springs," they became trapped in the gummy tar, which preserved their bones so well that now-50,000 years later-more than 8,000,000 of them have been recovered. Study of these specimens has resulted in 20 groups of models that will be placed in the park around the surface pools. Visitors to La Brea will have a glimpse of how the mastodon, saber-toothed tiger, and other monsters of the Ice Age lived and fought. And a floorless museum will afford them a view of ancient bones churning in the tar.

For a decade, sculptor Herman T. Beck has planned this display of the Pleistocene beasts. His work on the life-size models—made of concrete and metal-coated plaster—combines artistry with minute study of authentic remains. He first roughs out several poses of each animal in plaster, making

these figures scarcely larger than the human hand. After one has been selected for display, Beck starts the big job of producing a life-size replica. From careful measurements of bones he builds up the animal to one third the ultimate size. This completed, he places the creature in an enlarging frame, a simple structure of wood marked at one-third-inch intervals with nails. Readings taken can then be easily projected to inches for the life-size model.

Among the 3,000,000 specimens that Beck could use for study were bones of camels, bison, peccaries, odd-toed herbivorous perisodactyls (horses and tapirs), and such birds as road runners and eagles. When the final group is in place, the public will have an opportunity to see life forms whose size and power are unparalleled today.

Recently Beck made a death mask of an Indian tiger and plaster casts of the forelegs of an African lion. Comparing these with the great lion of the Ice Age, he found the latter had a head three times larger than the tiger's, while his limbs and feet were double those of his distant kin in Africa. Moreover, America's early lion weighed a half ton—several hundred pounds more than today's lion.

Most ferocious of the early visitors to the pits was the saber-toothed tiger. His upper front teeth projected downward in long, thin blades and were capable of deal-





Tar pits at La Brea, Calif., trapped thousands of mansters in the Ice Age. Now surrounding them are Infersize models of the animals created by Herman T. Beck, who made studies of bones found well preserved in the gummy tar, above. Left, he compares the forelegs of an African lian with feet of America's great lian

in Stone

ing death to smaller animals at a single blow. More than 1,500 saber-toothed skeletons are preserved at La Brea.

The wolf of which more than 2,000 specimens have been recovered from the pits was the largest wolf ever to inhabit North America. His head was one tenth longer than the timber wolf's—yet his brain was tiny. So powerful were his jaws that he could drag large animals from the tar and easily crush their bones.

Probably the imperial elephant will find no place in the Pleistocene park but the mastodon will make an appearance. Seventeen of these gargantuan creatures were found in a single pit 15 by 25 feet in area and 35 feet in depth. Their bones alone tell of the tragedy continuing for centuries

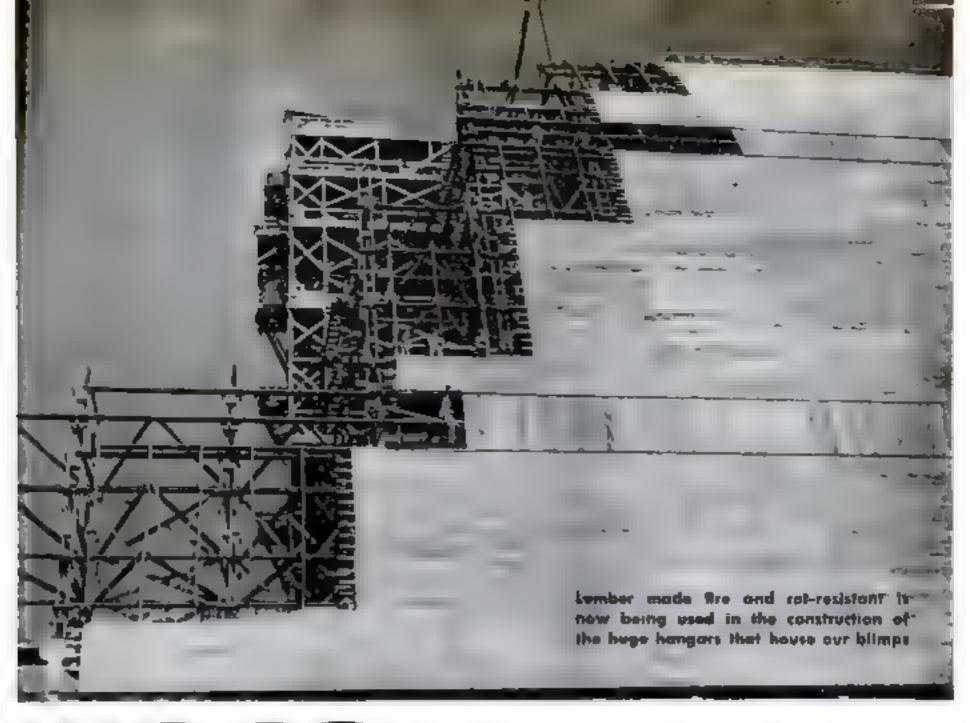
The remains of 72 giant ground sloths larger than the rhinoceros of today, have been recovered from the La Brea pits. Some of the specimens, as reconstructed from their bones, measured as much as 44½ mehes across the hips.

I. When preparing to model a pack of dire walves Back reassembles the banes of one of these ancient scavengers. 2. Experimental clay models, such as this group of lians, are used to judge the appearance of a full-size sculpture. 3. A model that is one-third life size is placed within a measuring frame marked at top and sides by nails at 1 3-inch intervals. Then, projection to a full-size model is simple









WOOD That Fights

Soaked with a chemical solution, ordinary lumber is now taking the tough jobs that only steel and stone were once able to do.

STRUNG along our coast lines are the stallest single-span timber structures in the world—17-story blimp hangars that stand as monuments to wood's new-won status as a "heavy" building material the equal of steel and masonry. Built as an experiment during the steel shortage, they showed the way for the wholesale use of lumber in war construction, which, in 1942 alone, saved over 400,000 tons of steel.

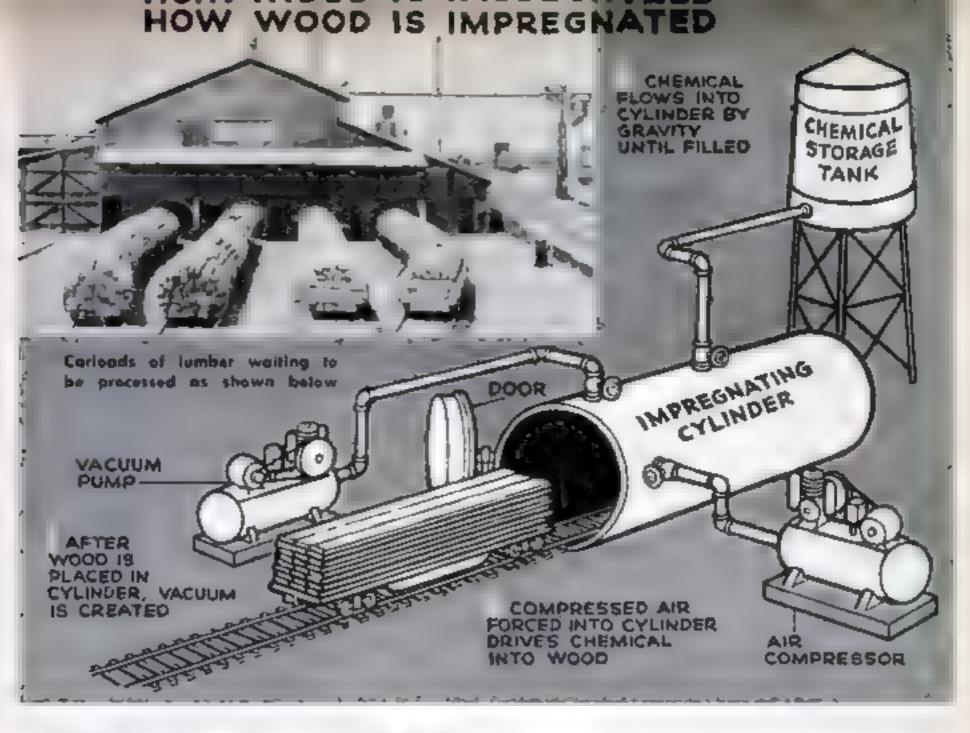
The secret lies, first, in a process of chemical impregnation that renders wood resistant to fire and rot, and, second, in a method of bracing its joints with steel rings. The result is a structural material that is no more like natural lumber than steel is like pig iron.

Treatment of the wood consists of forcing a chemical compound into its innermost tissues. Either of two compounds may be

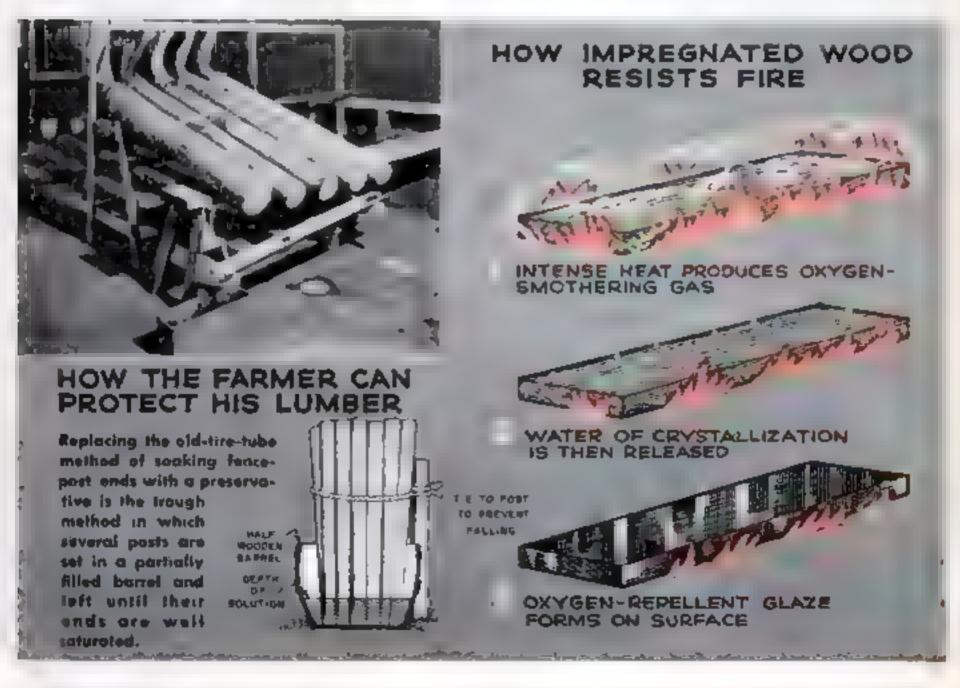
used—a mixture of ammonium and boron salts, chromate, and zine chloride, or a concentration of chromated zinc chloride. The chloride makes the cellulose in the wood unappetizing to termites and rot-producing fungi.

When wood treated with the ammonium compound is subjected to a flame, the ammonium salts give off a gas that smothers all exidation. The boron salts, in changing their composition, release water of crystallization that further cools the lumber. When completely fused, the boron salts form an exygen-repellent glass over the surface. These chemical changes create a hard, clinkerlike char that serves as an insulating blanket and bars deep penetration of the flames. The chromated zinc chloride works by coating the wood with a metallic, combustion-retarding film.

Wood treated with the ammonium mixture can stand an hour's exposure to a flame up to 1,700 degrees F. without igniting. Impregnation with chromated zinc chloride considerably reduces flame spread. Under actual fire conditions, treated wood will stand up longer than steel, for the latter is likely to buckle and collapse after short exposure to intensely hot flames.



Fire and Decay



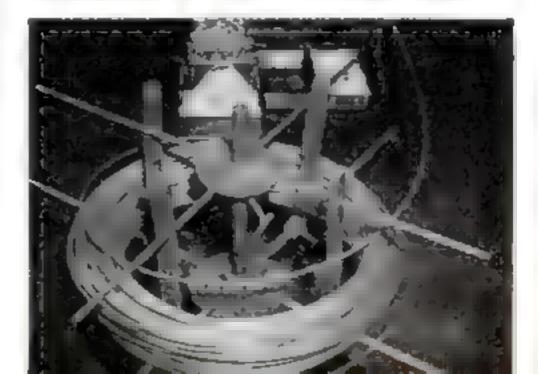


THE common rivet, a bit of metal consisting of a cylindrical shaft and a head, can claim a place among the things that are winning this war.

As the flaming list of American air victories has grown, words of praise have been showered on nearly everything connected with our combat planes, from their pilots to their propeller tips. But the rivet, which holds the plane together as it wings to its target and keeps it together on its way home after enemy flak and fighters have done their best to tear it apart, gets as much popular acclaim as a crack in the sidewalk.

The little pin deserves better notice, for, in the main, no superior way of joining the many thousand parts of an all-metal bomber, a fighter plane, or a flying boat has been discovered. Spot-welding, of course, is employed by some plane builders, but only to

THE RAW MATERIAL for airplane rivets is of two main types, known as 175 and A175. The former is composed of 95 percent aluminum, four percent copper, .5 percent manganese, .5 percent magnesium. The latter has 97.2 percent aluminum, 2.5 percent copper, .3 magnesium, with manganese omitted. These allays, in wire farm, are fed into a rivet-forming machine, or "cold header," right



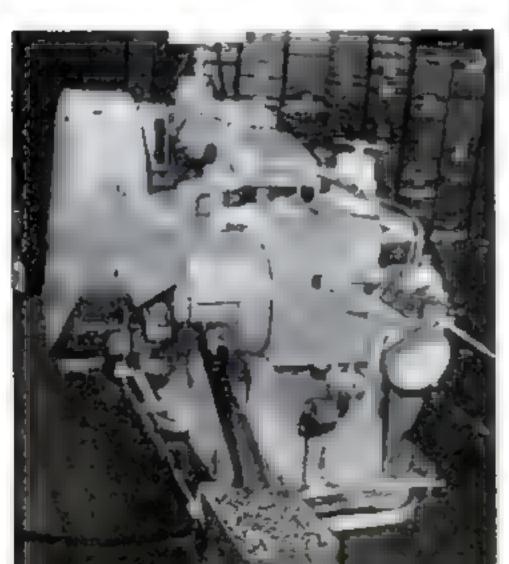
Tacks for the Axis

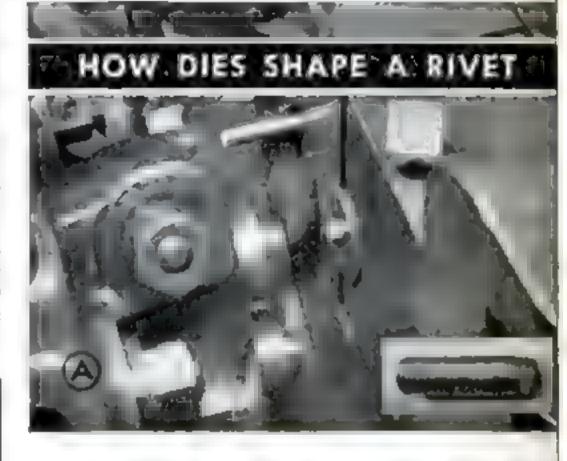
a limited degree. The task of sewing up a four-motor bomber, for instance, is entrusted to the rivet, or rather to more than 400,000 rivets with a combined weight of 560 pounds, which is less than 1/100 of the plane's total weight.

In warplane construction, far more rivets are used than any other item. At the Consolidated Vultee Aircraft Corporation's plant at San Diego, Calif., where the pictures accompanying this article were taken especially for POPULAR SCIENCE MONTHLY, batteries of machines produce more than 150,000,000 rivets every month. Each working day, 30 miles of soft wire are transformed into the metal fasteners. (Continued)



THE SIX MAIN TYPES of rivets used in planes are: (1) mushroom head, (2) 115-degree countersink, (3) 75-degree countersink, (4) brazier head, (5) flat head, and (6) cup head. High-speed "cold headers," such as the one below, turn out these rivets at the rate of 550 a minute, which is name too fast, considering that a single Liberator uses 400,000. The photographs at the right are close-ups of a cold header in action. At top, protruding wire is about to be cut. Middle, steel jaws carry wire to female die where first male die makes preliminary forming af head. Below, the second male die completes the forming

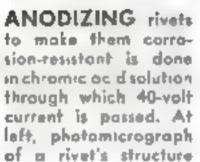














935 degrees F. Photomicrograph shows change in structure of rivet



REFRIGERATION. As soon as the 175 rivets have dried in the centrifuge, they are placed in the metal containers of a large refrigerator, where, inside of a few minutes, they are chilled to 10 degrees below zero F. This arrests the hardening process first set in motion by the sodium nitrate both, which enabled the copper in the plloy to disperse uniformly



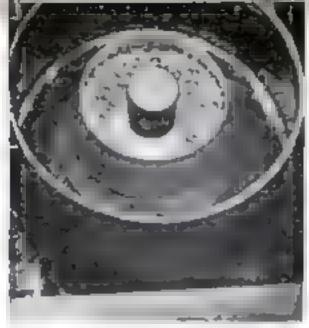
PACKAGING, 17S rivets are shown being put into small Cellophane bags that will be kept under refrigeration until the tivets are required. They must be used within 30 minutes ofter being removed from cold storage. When finally driven, the rivets, as they warm up, expand to fill the holes into which they are pounded

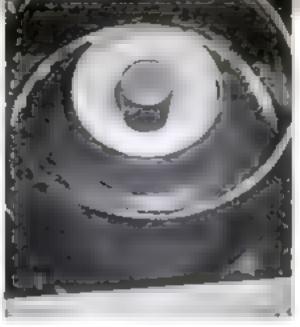
For aircraft construction, a rivet starts out as a piece of soft aluminum alloy. By the time it is ready for use it is a tough bit of alloy, three times stronger than the wire from which it was made. More than 800 sizes and head types are cataloged for use in military planes and flying boats. Of these, some 400 are currently used. They range from tiny name-plate fasteners 1/16 inch thick and 3/32 inch long to the big fellows that hold the wings to the fuselage. These measure % by 31/16 inches.

A glance at its head reveals the function of the rivet. The mushroom head is used where a rivet may be subjected to considerable tension. The brazier, with a flat underside and a flat-trajectory eval top, is

commonly used on the skin and fuselage, where it presents comparatively little drag to the air stream. The flat, as its name suggests, is level on both top and bottom and is usually employed in subassemblies where protrusion is not important. Although the cup resembles the mushroom, its underside is slightly concave, permitting the outer edge to broach the material being fastened, making a tight fit. The countersink, resembling a flathead screw, is normally driven into thin sheets where projections are undestrable.

The heading of a rivet is an entirely automatic operation, performed by a machine called a "cold header." But the making of rivets consists of considerably more than





A CENTRIFUGE that whirls them at 1,800 r.p.m. is used to dry the rivets after they have been quenched in a coldwater bath. Because of the difference in their composition, the 17S rivets, which must be able to withstand a greater tensile strain, are given a separate treatment from those of the A17S type, after each has gone through the quenching process. The former are ready for use after hardening for three days at room temperature. The latter, however, must first be refrigerated



merely stamping them out of long coils of wire.

Several alloys are available for the manufacture of rivets, but those for aircraft use are classified into two main types—178 and A178. The A178 type is generally used in the fuselage and skin assembly. The other type is employed where weight, high tensile strength, and resistance to corrosion are important factors. All rivets more than 3/16 inch in diameter are made of the 178 alloy; smaller ones may be made of either alloy.

The chemical difference between the two alloys is negligible, but even this small variation calls for vastly different treatments of the rivets. The 17S is composed of 95 percent aluminum, four percent cop-

per, .5 percent manganese, and .5 percent magnesium. The A17S contains 97.2 percent aluminum, 2.5 percent copper, and 8 percent magnesium, with manganese, the hardening agent, omitted.

Rivets made of both alloys are formed in the same manner. Colls of the alloy in wire form are fed into the cold headers. First, the machine cuts off a length of wire slightly longer than the rivet will be when completed. Steel jaws move the rivet blank in front of a female die slightly shorter and .003 inch wider than the rivet to be headed and press it into the die. Two male dies strike the blank to form the head. Then the rivet is blown down a chute into a pan.

At this stage the rivets are not strong enough to hold airplane parts together. The first step in hardening them and making them corrosion-resistant consists of anodizing. Small lots of the rivets are packed tightly in perforated aluminum containers, each rivet pressed against its neighbors to make sure an electrical contact can be made.

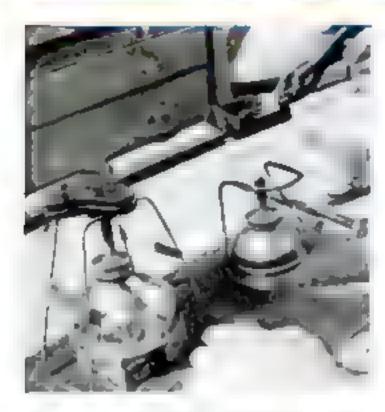
In the anodizing process, the containers are dipped in a boiling solution of Kellite, which pours through the perforations and removes all oil from the rivets. Next the rivets are rinsed in hot water, and then dipped for 30 minutes in a long tank containing a 10-percent solution of chromic acid through which a 40-volt current of electricity is passed.

This coats the rivets with dull-gray aluminum exide. A final hot-water bath washes off any remaining acid.

The rivets now are corrosion-resistant, but they are not yet strong. Once more, in four-pound lots, they are packed into long, harrow, perforated containers, and given a heat treatment. The containers are lowered one by one into a sodium nitrate solution heated to 935 degrees F. in an open furnace. During this 45-minute bath a molecular rearrangement takes place, the copper going into solution and dispersing uniformly throughout the rivets. Hardening takes place as the copper-aluminum precipitates out of the aluminum base in minute particles. Within 10 (Continued on page 198)

Midget Plane Factory

ACCURATELY SCALED MINIATURES MADE DE SCRAP METAL

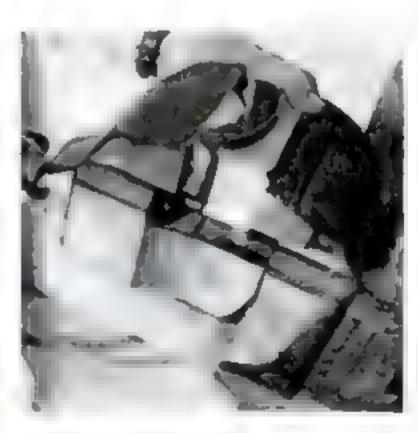






PROPELLERS. Heading Vultee's 10-man model-building department are the Doering twins, Harvey (left) and Howard, who are shown finishing a botch of tiny, molded propellers. At upper left are the burners, improvised from oil cans and baling wire, that are used in melting down the metal from which the propellers are made. On top of the burner in the foreground is one of the molds in which the propellers are formed. At the left is a view of the bottom half of a mold





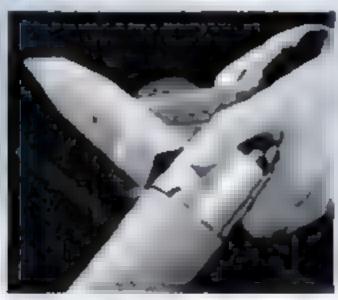
PRESSURE FORMING is used for many of the models' parts. In making the engine nocelles, the outline of a template is marked on the raw material, and the material is then cut. Blanks are then placed in dies and squeezed between the jaws of a bench vise, as shown above. The finished jobs are shown in the foreground of the photograph at the left

Mass-Produces Models

ROLL OFF LILLIPUTIAN ASSEMBLY LINES FOR ARMY USE

AT CONSOLIDATED Vultee Aircraft Corp., Vultee Field, Calif., Howard and Harvey Doering, 23-year-old twins, are turning out planes not more than a few feet long. Heading a 10-man department, they are making models of the B-24 Liberator,

MACHINES employed in making the models are miniatures of those used in building full-size planes. Here rollers fashion a metal place



HAND FORMING metal sections of a model is done by placing the metal on a wooden form, and then hammering it into the proper shape

JOINING the model parts is done by soldering. Here the iron is being put to a section of fuselage while it is held in shape on a wooden form



the Vengeance dive bomber, and the Valuant basic trainer for use by Army and Navy preflight instructors.

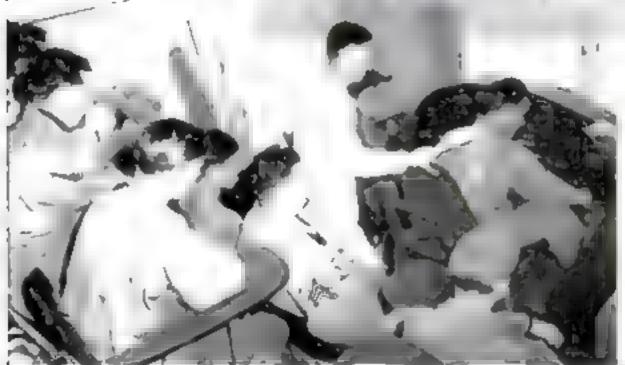
From a blueprint, a scaled mock-up is made—a model whittled from wood. Plaster casts, made of various parts of the model, are then used to fashion the necessary dies. From this point on, only scrap metal—usually sections of old tin cans—is used in building the models. Tiny, but extremely accurate, templates provide the patterns for cutting the metal. The resulting blanks are then placed in the dies and subjected to the pressure of either a bench vise or one of the drop hammers used in making the full-size planes.

After the die-formed pieces have been trimmed, the plane's parts are ready to be assembled. Joining is done solely by soldering, after which the joints are filed smooth.



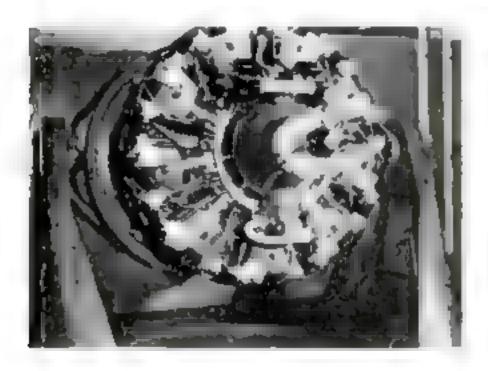
ASSEMBLY LINE. A jig, made of a piece of plywood and some clothespins, holds the wing of a "8-24" in piece while it is being soldered on. Scrap metal and wood are used almost exclusively in the models. When assembly is completed, soldered joints are filed, and the ships are painted with a spray gun





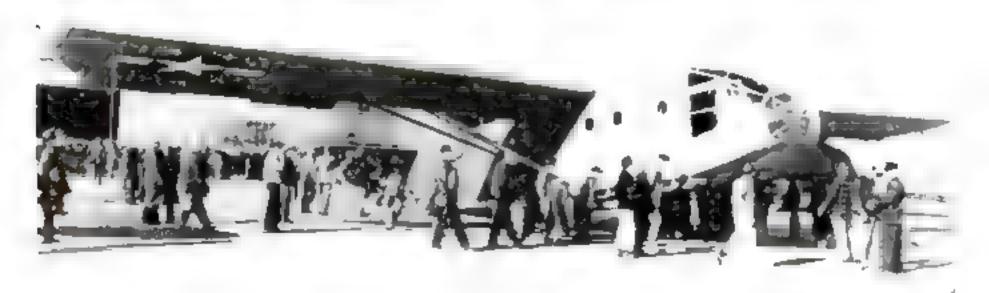
CLASSROOM COCKPIT.

To train ground crews in the operation of a B-17's engines, the Boeing Flying Fortress School, at Seattle, has built an "enginerun house" (above) where students sit in a model cockpit and learn to handle the engine controls. Through a window, the students can observe the action of engines mounted on a wing outside.



2,200 HORSEPOWER has been packed into this comparatively small Wright Cyclone engine, now in quantity production for long-range planes. It carries 18 cylinders, arranged in two banks of nine, and has a diameter of only 55 inches.

LARGEST GLIDER ever built for the Army Air Forces is shown below as it was being made ready for a test flight at Wold-Chamberlain Field, Minneapolis. Built by the Northwestern Aeronautical Corp., the glider has a greater load capacity than the two-motored Douglas ship used commercially.





Tubing that has been quickly and occurately assembled on a jig (right) is shown being installed in the fuselage of a C-47 Skytrain

"JIG-TIME" ASSEMBLY of tubing used in C-47 Skytrains is made possible by the use of jigs that save many man-hours in the building of these mammoth transports, Below, a woman worker at the Douglas plant, Long Beach, Calif., is shown putting together the "arteries" that will serve a ship's engines, de-icing equipment, and instrument panels.



FLYING FURNACES. Known as the "Janitrol," a combustion-type heater weighing only six pounds is serving to keep vital sections of big planes warm (see below) even when the outside temperature drops to 70 below. Utilizing the "whirl-flame" principle, these heaters are seeing service in American and Canadian planes operating in cold climates. Surface Combustion, of Toledo, Ohio, is both the designer and manufacturer of these heating units.



ENGRAND MAR (SA)

This lightweight heater, used in both American and Canadian fighting planes, can be held in one hand

The diagram at the left illustrates the placing of the units to heat such vital sections of a plane as the leading wing edges, fore and aft gun turrets, and main cabin. Units are also used to warm engines prior to the take-off



Underwater assignments train Navy divers for the difficult, dangerous work of salvage.

N INTENSIVE, 14-week training course turns ambitious young carpenter's mates, steam fitters, and machinist's mates into "underwater mechanics" at the Navy's diving and salvage school, Pier 88, North River, New York City. More than 400 bluejackets now enrolled, and 50 more volunteering every two weeks, will help fill the pressing need for men who know how to raise sunken ships all over the world. Diving assignments from moored floats, in water so murky that a student must work by sense of feel, apply classroom lessons. Photos on these pages show some of the exercises that novices learn to perform. Eventually they become able to open and close valves and repair piping in a vessel on the bottom, and to apply patches and bulkheads of many types.





USING A HACKSAW. Diving itself is only part of a diver's job. The important thing is for him to know how to handle tools and make repairs once he has been lowered into the water. The pictures on this page are above-surface photographs of some of the jobs he may be called on to do—often in water so murky that he cannot see, and must rely solely on his sense of touch

CONNECTING A PIPE FLANGE is another common diver's job. Young Novy corpenters and machinists are now volunteering at the rate of 25 a week for the hazardous job of practicing their trades under water. Physically, they must be able to withstand great pressures. Emotionally, they must be able to overcome that first terrifying sensation when locked into a diving suit

REPAIRING A PONTON. A ponton with a leaky gasket is tassed overboard. A student diver goes down, locates it, changes the gasket, affixes on oir hase, and comes up. His instructor turns on the air valve. If the ponton bobs to the surface, the student "passes." If it doesn't, he flunks—and takes another dive

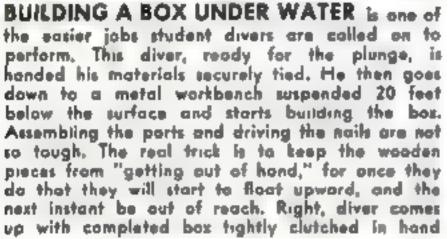
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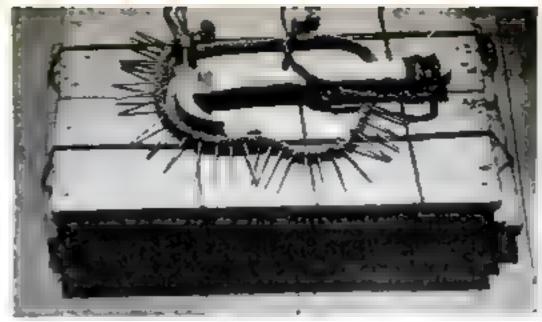
A PIPE-FITTING JOB, Working on a muddy bottom into which he may sink, a diver, by regulating intoke and exhaust valves, can reduce his buoyancy slightly, and then half swim, half wallow his way along. Or he can increase his buoyancy slightly and walk on the bottom in a sort of light-footed dance







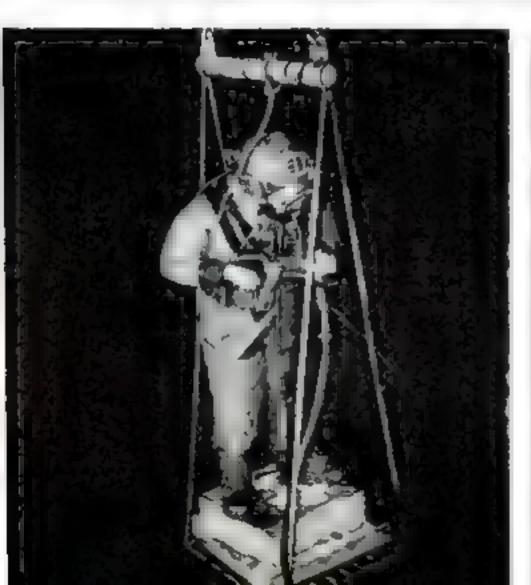




Materials for the box consist of bottom and side pieces, nails stuck through a short rope, and a hammer with languard to be tied to diver's wrist



DRILLING with a power-driven auger or jackhammer isn't an easy job even an dry land. Yet divers must be able to aperate these tools at deep-sea levels. In the pictures below (simulating underwater views), the diver at the left is shown drilling a block of concrete. At right, boring holes in a piece of lumber. Metal stages, swung from crones, are used by salvage boats to lower divers and their equipment over the side. Taughest and most important job a diver can do is to go down into murky water to inspect a wreck. Groping his way inch by inch over the damaged area, letting his fingers do the work of his eyes, he must then be able to come up and show what repairs are needed in an accurate sketch that can be used in planning the best salvage method







CLASS WORK. Here an instructor explains the operation of the chin valve, an important part of the diver's hoimet. How well these students learn their lesson may some day prove to be a matter of life and death to them





A DIVER'S TORCH uses the intense heat of hydrogen burning in oxygen, each gas being supplied by a hose. A third hase furnishes air that forms a protective bubble around the flame

A DIVER'S HANDLERS DRESS HIM FOR THE DEEP



I. Preparing for a dive, this student works up a good soap lather on his hands. This prevents his wrists from becoming chafed by the sleeve cuffs and also aids in preserving a watertight seal. 2 To make sure he doesn't bob to the surface because of insufficient weight a diver must hoof it in 34-pound iron shoes

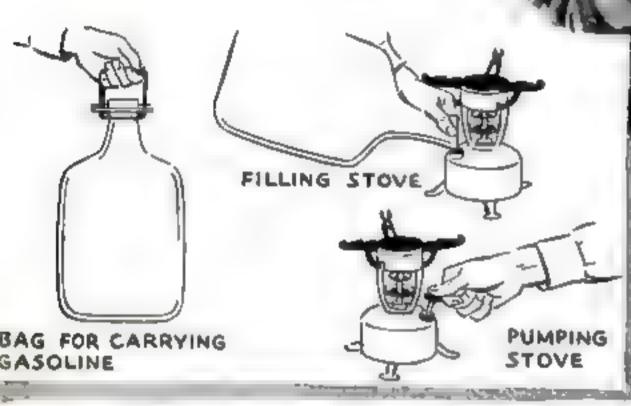


3. Here the breastplate has been bolted in place. One of a divers difficulties is having to work in a suit that very often weight more than he does. 4 To the top of the breastplate is screwed the all-important helmet. When lines have been given a final adjustment, faceplate is closed—and down he goes

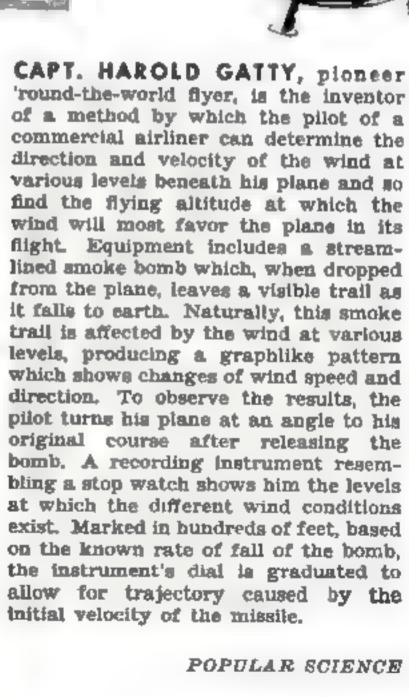


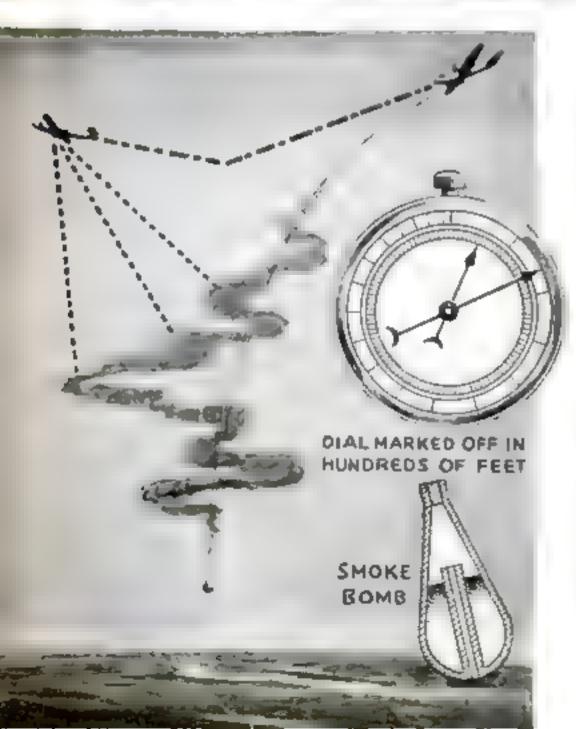


HOT MEALS can be enjoyed by aircombat crews at advanced flying fields, thanks to an Emergency Sustenance Kit developed by the Army Air Forces Materiel Command, Wright Field, Dayton, Ohio. Nested compactly in a canvas bag and weighing only 514 pounds. the outfit includes a small gasolineburning pressure stove with protective shield, two stewpans, a frying pan, a hot-pan holder, and a one-gallon fuel bag. The stove burns the high-octane leaded gasoline used in military aircraft, and the bag is designed to resist the corrosive effect of fuel drained from a plane's engine or tank. The shield can be used as a wood-burning stove.



WOOD can burned on fuel if desired. The gasoline pressure stove is removed from the protective shield, which itself serves as a stove







Carrying barges on a series of "phantom" decks high above the uriginal top deck of a freighter. Waves wash under without disturbing the cargo

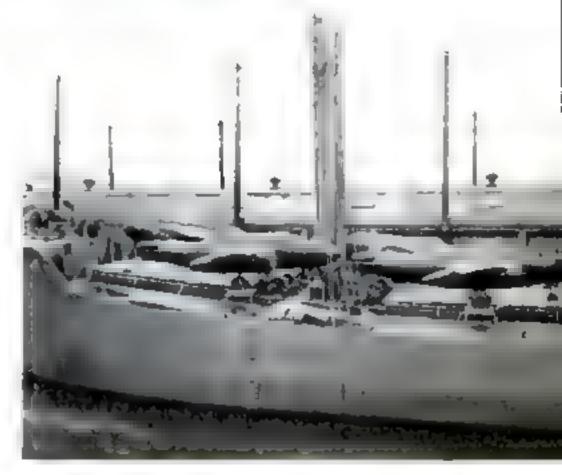
Below, steel tobies toke the place of the wooden slats at left for holding Douglas Havocs. Table legs are bolted to angles welded to the deck

Pickaback Cargoes

Since 1940, through the ingenious addition of skeleton "upper stories" to their decks, Allied merchant ships have consistently been loaded to 10 percent above normal without having a single piece of cargo washed overboard, it has been revealed by the War Shipping Administration. These new "phantom" decks are intermittently spaced tables that rise 15 feet from the original top deck, thus affording clearance for waves.

The cargo is lashed to the ship proper by wire cables connected through turnbuckles to sturdy pad eyes welded solidly to the deck floor, and the supporting tables are themselves bolted to steel holders or angles also welded to the deck. These angles and pad eyes can be burned off with acetylene torches within a few hours after a freighter or tanker docks, if the decks must be cleared for new kinds of cargo.

Credit for the development of the scheme is due the West Side Iron Works—in 1939 a modest blacksmith's shop in New York's Greenwich Village, and today a huge business with 11 plants and a national reputation for ingenuity and efficiency.



Lashed securely with wire cobles, the P-38 below rides on top of a tanker. Fittings to which its table is bolted can be removed on the next voyage for a different cargo





WEIGHING half as much as former types, an "assault combat mask" developed by the Chemical Warfare Service dispenses with the familiar breathing tube leading to a separate canister. Instead, the air-purifying canister is built into the side of the mask, as shown in the photo at left. If dropped in the water, it will float and may easily be recovered. A carrying case also holds transparent eye shields for use without the mask, and a garment to shield the body from blister gases, together with special continent for treating blisters. An antifogging chemical also is provided for use in keeping the mask eyepieces from clouding.

TEMPERATURES fail as low as 40 degrees below zero, and air pressure drops from a normal 15 pounds to only four pounds, in a wind tunnel nearing completion for the National Advisory Committee for Aeronautics at Cleveland, Ohio. Simultaneously, gales up to 500 miles an hour will rush through the tube



FITTING the Army's modern Garand rifle, an attachment of new design permits use of the weapon for firing grenades and signal flares. As a grenade thrower, the device converts the Garand into an effective antitank weapon, At left, the illustration shows a grenade for this purpose about to be mounted in place, while other types of missiles line the table. The invention is said to eliminate need for carrying older-type Springfield rifles for this particular purpose, Ray S. Miller, at right in photo, and Col. Charles H. Coates, center, designed the launcher at Fort Benning, Ga.



Sections of trees riddled by Black Hills beetles. Above, the penknife touches an adult in its tunnel; at right, the fingers point out larvae



War Waged on Tree-Killing Beetle

HE strategy of man's recurrent wars against insects is typified by the annual winter and spring campaign in the Rockies against the deadly Black Hills beetle. Dendroctonus ponderosas (literally meaning tree-killer), which destroys great pine trees during its reproductive process.

The parent beetle, not more than three tenths of an inch long, bores its way into the inner bark—the cambium layer—of a pine by September, and soon after this, when "pitch pockets" show on the outer bark, betraying the presence of the killer, man begins his war. If undisturbed, the larvae from eggs deposited in the sawdust-filled cavity tunnel at right angles to the parent's

bole, girdling a tree scores of times and blocking the flow of sap through the inner bark. This continues until well into July, when the larvae, now full-grown adults, take flight, and carry the destructive cycle to other trees, some of them miles away.

Crews of men from Federal, state, and county agencies push through the mountains all winter, hunting out and marking infected trees, to be followed by other crews bearing axes. The host trees are stripped shoulder high, to expose eggs or larvae to sunlight and air, which kill them, then the trees are cut down and burned—in one year alone this amounted to 50,000 trees. In some cases, logs can be salvaged.

Fire is the cure against spread of the tree-killer, Infected pines are marked, felled, and burned



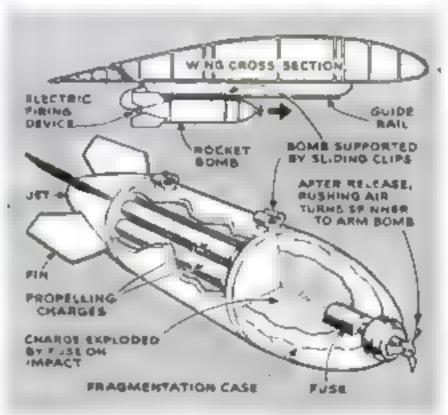
Cokets Gain Punch STEPPED-UP FIREPOWER IS SOUGHT BY IMPROVEMENTS IN PROJECTILES

Doth our Russian allies and the Germans have recently brought into play some new ideas in rocket explosives, the former seeming to have attained by far the greater success as measured by reports from the front. The essential differences in the practice of the two are that the Germans lean to ground-to-ground and plane-to-plane use of the fast-moving explosives, while the Russians employ their rocket as a bomb from plane-to-ground installations.

German rocket guns throw their projectiles in a lob at enemy ground positions and have gained range from the series of blasts that sends the explosive shell forward in a succession of leaps. What the Nazis can do with their giant cross-Channel "secret" rockets remains to be seen. Plane-to-plane fighting, however, after an initial auccess against Flying Fortresses, ran into a simple American defense. Extra fuel tanks enabled fast Thunderbolts and Lightnings to cover bombers on an entire mission and pick off the slower rocket planes.

The Russian rocket bomb has been particularly effective against German tanks, while their planes were subjected to no more than the ordinary flak defense

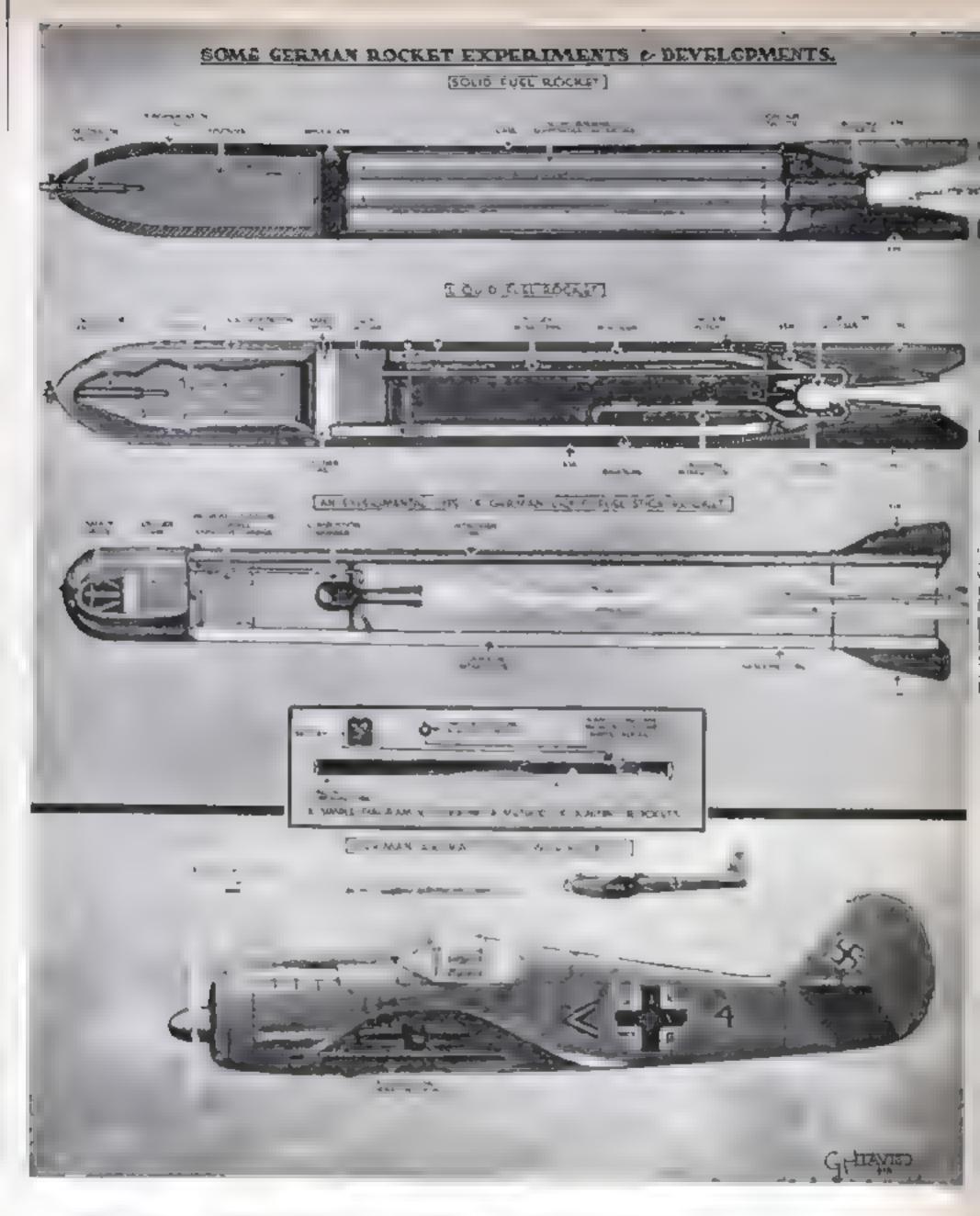




RUSSIAN ROCKET BOMB. This new type of bomb is shot from rails under the wings of a plane. The spinner is a safety device which unwinds with the wind and exposes the detanator

GERMAN ROCKET GUNS. Firing a self-propelled shell at long range, the gun at the left is being sighted by one Nazl soldier while another connects one of the detonators. Below, a crew runs forward to reload a rocket gun that has just been fired. In the foreground is another gun





How rockets on Luftwaffe fighters are propelled is shown in these drawings by G. H. Davis, noted artist of the Illustrated Landon News, who saw some of the development in progress in a suburb of Berlin before the war. Two types of propuls an are used by the Germans—a slow-burning powder and a liquid fuel the latter still experimental when viewed by Mr. Davis, but offering greater possibilities should the Natis learn to control the fierce heat resulting from combustion. Rocket firing tubes are attached to the planes under the wings



Marked with American flags and insignia to prevent its being shot down by overzealous Allied fighters or AA-gun crews, this German Junkers JU-88 high-altitude bomber was flown from Africa to Wright Field

Nazi Plane Yields Secrets

HERE'S ONE GERMAN BOMBER THAT FLEW TO AMERICA— BUT IT TOOK A COUPLE OF USAAF MEN TO GET IT HERE

PERHAPS the most closely guarded aircraft at Wright Field, Dayton, Ohio, is Baksheesh, the first German combat plane to fly the Atlantic—luckily, with an American crew.

This German Junkers JU-88 high-altitude bomber was deliberately flown into the hands of the Allied Command by a young Nazi pilot fed up with the whole business. The two arrived at a field on the island of Cyprus last September, to the delighted bewilderment of all concerned, except the pilot.

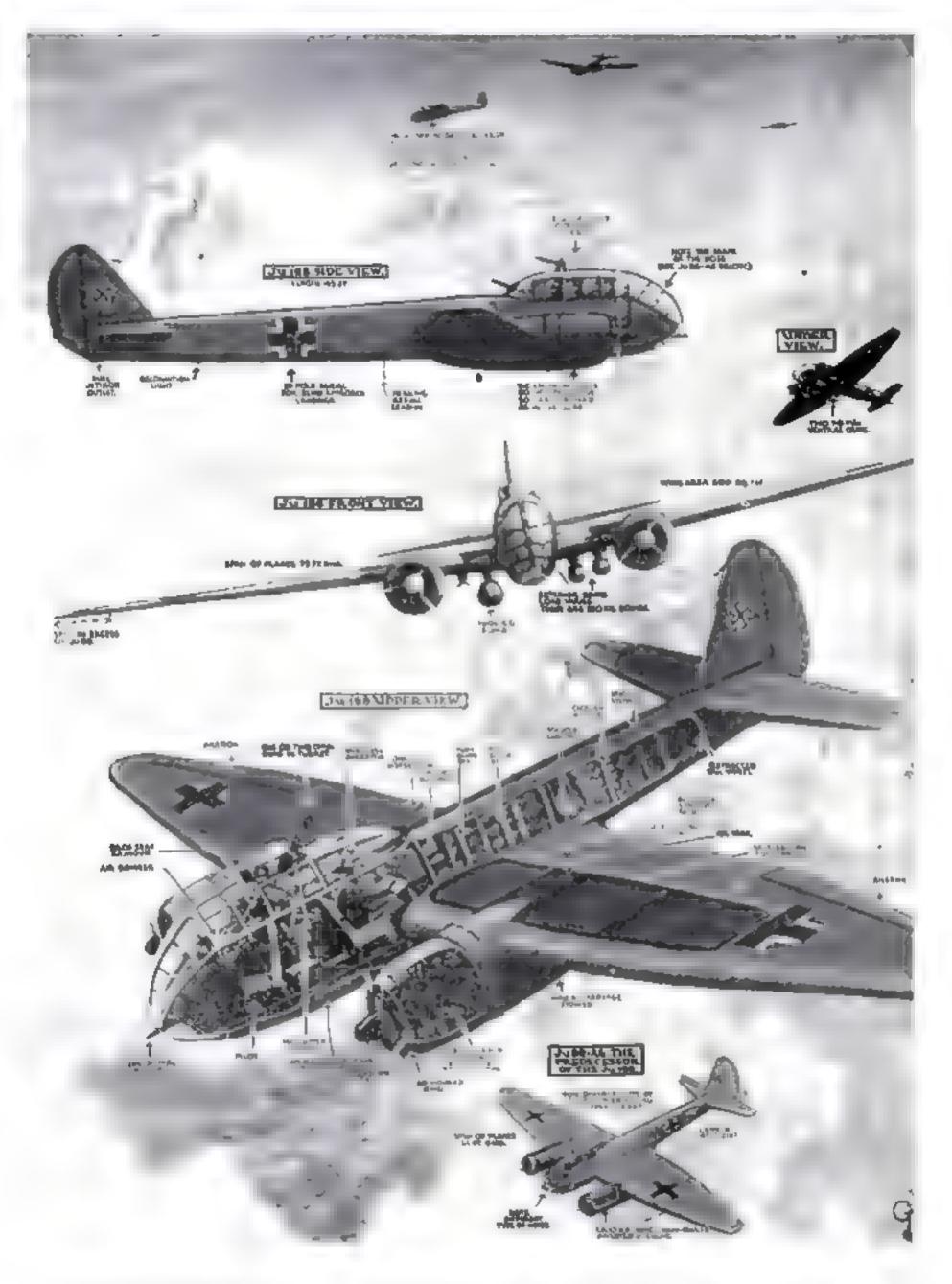
Almost brand new, with less than 50 hours' flying logged, the plane was test-flown by the British and then, through diplomatic arrangements, turned over to the AAF for evaluation. Marked with American flags and insignia, it was flown to Wright Field by Maj. Warner E. Newby and Lieut. G. W. Cook, AAF, giving some of our aircraft spotters a thrill on the way.

Baksheesh, Persian for "something for nothing," proved to be a fighting man's airplane; rough-and-ready, tough, and (to quote the Major) the "heaviest and most vicious airplane I had ever flown." It also had, still to quote the Major, "more damned gadgets than any plane I had ever seen."

The JU-88 was minutely inspected and studied before leaving Africa and fitted with auxiliary gas tanks from a Lockheed Lightning. In testing the emergency dropping gear for the tanks, Lieutenant Cook received shrapne, wounds in his back. He was under the tank during the testing, and the Bombenbe/reiung (bomb-release) button accidentally set off explosive charges in the wing, which blew the tank, shackle, and bomb rack to which it was attached right off the wing.

This incident led to another thorough inspection of the craft for other "tricky" devices. It was lucky this was done, for another button was found wired to set off explosive charges in the tail and completely demolish it. This explains why so many Nazi planes have been captured with their tails missing but otherwise undamaged.

Flying back to the United States in hops of from 900 to nearly 1,500 miles at an average speed of 240 m.p.h., the Junkers clicked off the 12,000 miles in 51/4 days. The aircraft gave little trouble, considering the nonregulation fuel and equipment that had to be used and the myriads of unknown buttons and unfamiliar gadgets the two men had to work with. Their opinion of the aircraft is high; it flew well, the radio compass was very good, and the automatic pilot and navigational equipment were efficient. To these, and to the skill of Major Newby and Lieutenant Cook, goes the credit for the first flight of a German combat plane across the Atlantic.



JU-88'S SUCCESSOR, Germany's new JU-188, is compared with the plane recently brought to America in this drawing by G. H. Davis for the Illustrated London News. With slightly greater length and span, the 188 has a new nose and cockpit cover, an upper turnet, and more powerful engines than the 88. Capture of a new, undamaged ship gives our Air Forces men a rare chance to study secrets of design

MARCH, 1944 79



CLEANING UP tough spots in an advance is the specialty of the Army's M-8 motor gun carriage. Consisting of a 75-millimeter "pack" howitzer mounted on an M-5 light tank chassis powered by two Cadillac eight-cylinder engines, it is described as the fastest and most maneuverable weapon of its type.

FLAK HELMETS developed by the AAF Materiel Command give our combat airmen maximum protection from antiaircraft shell fragments. The M-4 flak helmet, shown at right, fits over earphones, microphone, oxygen mask, and all other standard flying equipment.





GRUMMAN HELLCAT (F6F) U. S. NAVY FIGHTER

N THIS, the second of a series of full-color pin-up pictures of American warplanes, Jo Kotula has painted the U. S. Navy's terrific new Helicat fighter in action. Built to the specifications of pilots who had been up against the Jap Zero, the F6F is considered the world's most powerful carrier-based plane, with its heavy armor, lightning maneuverability, and great climbing speed.

NEXT MONTH: VOUGHT F4U CORSAIR FIGHTER

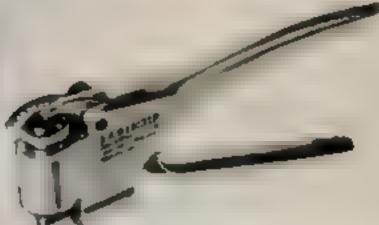




A RIVETING MACHINE GUN now makes joints from one side only, needing no bucking bar or back support. Threaded on pianowire mandrels, a supply of special hollow rivets is inserted in the gun. The operator simply turns the handle, and the rivets are

set as the withdrawal of the mandrel brings the plates together and expands the rivets, filling up inaccurately aligned holes. The new device, made by R. Decat, of Elmhurst, N. Y., is lightweight and upsets 1,200 rivets in an hour.





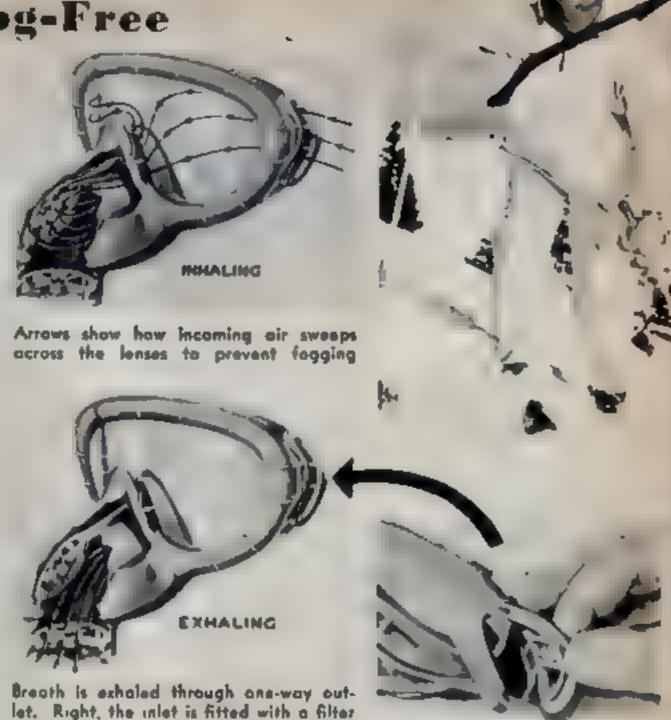
HARDNESS GAUGE. Four uneven teeth test the hardness of
alloys used in aircraft construction, in a gauge developed by
R. A. Webster. Santa Monica.
Calif. Hardness is indicated by
the number of tooth impressions
left on a tested object. Only a
slight hand grip is needed, as a
load spring controls the pressure.
Left, workers at Douglas Aircraft, Inc., checking metal parts.

NUTS are automatically inserted into metal plates by a feeder developed by engineers at North American Aviation. Inc. Fed from a hopper as seen at right, the nuts slide down a guide and drop into holes as the plate is revolved by the two upright spindles that hold it in place. Hand or foot-operated controls halt the flow while another plate is inserted.



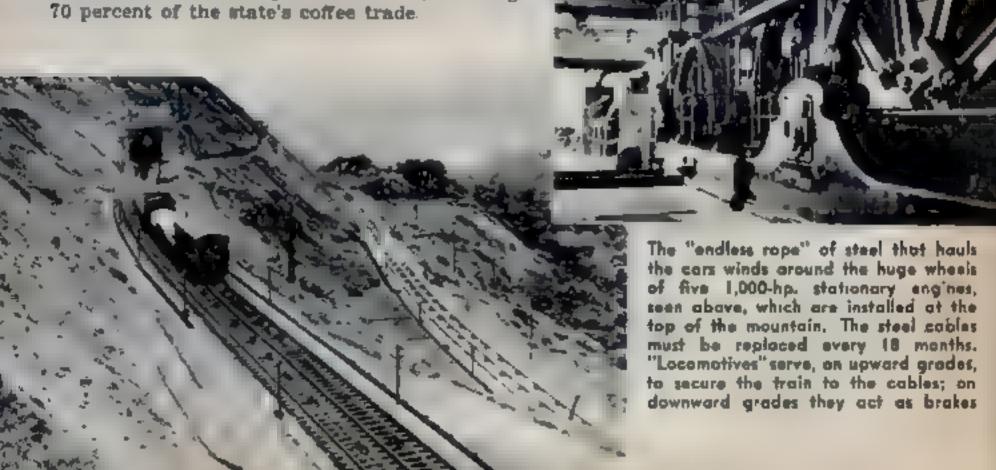
Ventilation Keeps Goggles Fog-Free

COGPROOF goggles fitted with plastic windfoil lenses have been developed by Polaroid Corporation, of Cambridge, Mass., for use by military personnel. With each inhalation of the wearer, a stream of fresh air is drawn into the goggle cavity through felt filters located at the sides of the goggles. This fresh air sweeps across the lenses and prevents any condensation of the moisture given off by perapiration and by the tear glands and mucous membranes around the eyes. The incoming air then passes through a one-way inlet valve and into the nose. When the wearer exhales, the action closes the inlet valve and opens a one-way outlet valve at the base of the noseplece. This prevents the moisture-laden air from returning.



Cables Pull Brazilian Coffee Trains

AN ENDLESS-ROPE railway in Brazil connects the industrial city of Sao Paulo with the seaport of Santos. Wire cables coating \$10,000 apiece are laid between the tracks, which traverse a sharp spine of rock separating the cities. The railway is a "life line," hauling 70 percent of the state's coffee trade.



Know The Worlds Warplanes UNITED STATES THESE BELGIUM hubbt BOLIVIA BRAZIL WHISE WPER SURFACE BRITISH WINIS THE PER **EMPIRE** WHIRE SUPPACE CUBA CZECHOSŁOVAKIA. U. S. S. R. DODUZ. WINCS RUSDES WHIGS DOMINICAN CHINA REPUBLIC RUBBER RUPDER WINGS WINGS ... AND THESE ARE THE MARKINGS **JAPAN** GERMANY











By Their Battle Markings

DO YOU know the insignia of the United Nations air forces and their unemies? To the carthbound civilian, these colorful markings may seem to be a superfluous adornment, but to the combat pilot they spell the difference between a welcome comrade and a dangerous enemy.

Thirted States warplanes now carry the new insignia displayed on the P-47 Republic Thunderbolt at the left. The new design differs from the old by the addition of a blue-bordered white bar to the familiar white star on a blue circle. Wing hungain of American planes are carried only on the upper surface:

the right. Fuselage imagein appear on both sides, midway between wing and stabilizer. Below are shown the insignia of the air forces of the United Nations and of other leading air powers. Like our full-color reproductions of Army and Navy medals and decorations (P.S.M., Aug. '43, p. 56) and of the flags of the United Nations (P.S.M., Feb. '44, p. 52), this feature has permanent value for framing and for reference. Watch future insure of Popular Science Monthly for similar features combining pictorial beauty, timely interest, and lasting value.

ARE THE INSIGNIA OF THE UNITED NATIONS



OF THE OTHER LEADING AIR POWERS











RUMANIA

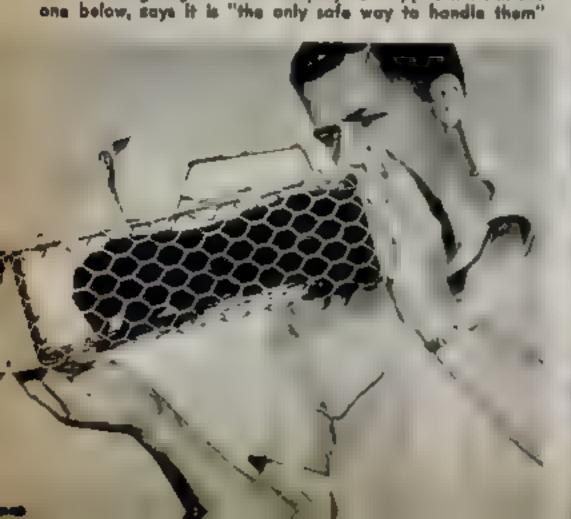


Minks on Turner's ranch at Goshen, N. Y., live in bases like that shown above, set in serried raws on a grassy incline to provide shade and drainage. The feed bas is for the young

When ready for "pelting," minks are lured from their homes Into catching cages. Turner displays a trapped mink in the

the pride of feminine wardrobes, according to Wallace D. Turner, who, in partnership with Edward T. Clark. runs the 600-acre American Fur Farm at Goshen, N. Y. Experimenting genetically with minks that possess an unusual number of white hairs-present in all genuine mink pelte-Turner has developed a strain with silvery akins, These will shortly go on the market, selling for around \$500 apiece, a spectacular contrast with the current \$34 cetting price for the usual mink pelt. Turner feeds his 1,200 needle-toothed fur bearers a special diet of horse meat. tomatoes, cereal, aifaifa, and fish, and ends their days with cyanide gas.

A diet full of vitamins and minerals is given the minks. Much vitamin A means lustrous fur







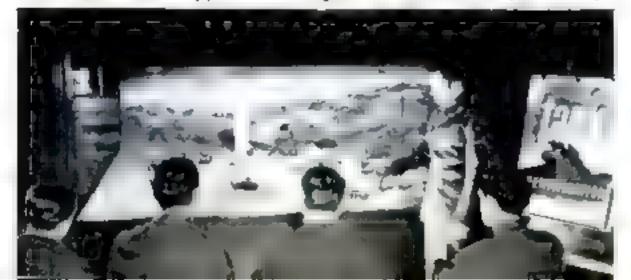
A wooden pilot model carved in four separate parts—hull, turret, and two track assemblies—is the first form of the tank models. Above, details of one are shecked with mechanical drawing

Tom Thumb Tanks

ACCURATELY MOLDED MODELS
TRAIN OUR DESTROYER CREWS
TO TELL FRIEND FROM ENEMY

TANK-DESTROYER units, pledged to "Seek, Strike, Destroy," learn to avoid belated or mistaken identification of enemy tanks at the Armored Force School, Fort Knox, Ky. Here, the Tactics Department turns out models of tanks on a miniature assembly line, for teaching soldiers to distinguish between Allied and enemy tanks. These small-scale blits wagons are placed on an identification table bearing replicas of farmhouses and other landscape features. Colored lights on the diorama simulate the effects of sunlight from dawn till dusk and even moonlight, sharpening the students' ability to identify tanks around the clock. Built to a scale of 1 to 32, the models can be studied for their appearance at varying distances, by calculating the theoretical range from which the students view them.

An instructor points out various lighting effects on the model of an American M-4 tank. From where the students are viewing the diorama, the scene appears as though it were about 200 yards away

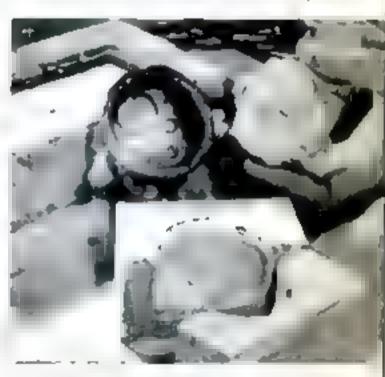




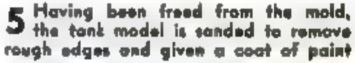
2 Several coats of quick-drying rubber are applied to the pilot model with care, lest air bubbles pit the drying mold



3 When the pilot model has been removed, the rubber mold is encased in plaster of Paris and filled with plastic



4 Baking takes place in a heat closet for three hours at 135 degrees F. Next, rubber and plaster are removed





GIRL ESCORTS who drive scooter taxis and scooter fire engines are helping to solve the manpower problem at Grumman Aircraft, ' Bethpage, N. Y. Acting as a cabby, one girl drives test pilots to planes on the field. Another girl follows with her "fire-bottle" wagon and stands by with cylinders of carbon dioxide, ready to douse any fiames that may break out while the plane's engines are being started. The cylinders were designed by Walter Kidds & Co., of New York. The plane shown is the Grumman Goose, an amphibian used by the Navy and Coast Guard for longrange patrol.



infantry badges. Worn in the same manner as the wings of Air Forces flying personnel, the two badges reproduced full size at the right have been authorized for award to qualified officers and enlisted men of the infantry. The Expert Infantryman Badge (top) will be given to men who qualify in the use of infantry weapons, make a good score in physical-efficiency tests, and demonstrate proficiency in tactics. The Combat Infantryman Badge will be earned by good conduct in battle.



'03 MODEL, Back in the days when buggy riders greeted passing autoists with "Get a horse!" the Oldsmobile was one of the gas-fed pioneers that roared up and down country roads at breakneck speeds of 15 and 20 miles an hour. The model at the left, of a 1903 "Olds," is one of more than 50 built by J. N. Halsted, Omaha, Neb., who has been turning out models of various makes for the past 10 years. It is highly detailed and carefully made to scale. Complete data on the construction of the model may be found in the Home and Workshop section of this issue.

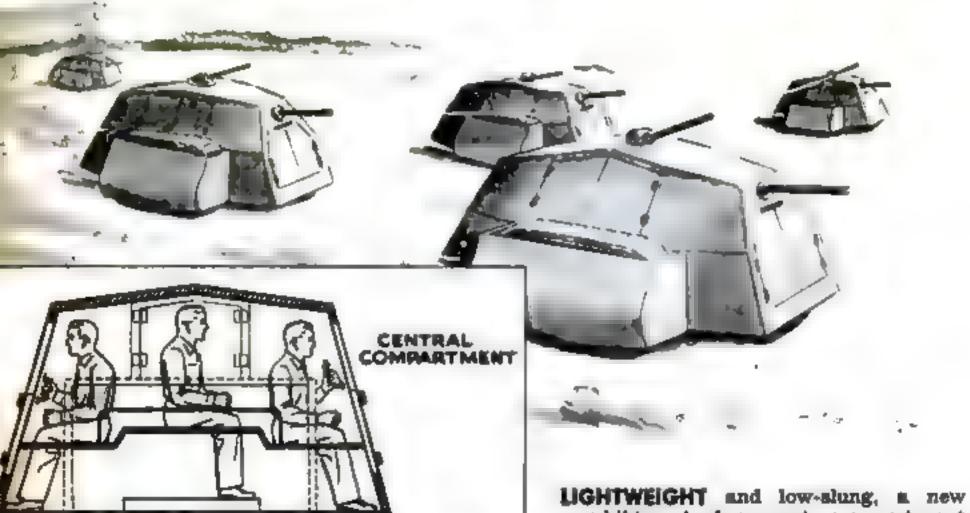


Color Camera Catches Birth of a Volcano First color photographs of the birth of a volcane were made recently in Mexico, where a placed field was transformed almost evernight into a towering cone belching smake, flames, and lava. Heralded by local earthquakes, the infant volcane Paracutin first appeared as a column of smake rising from a depression in the ground. Within a few weeks it had thrown up a cone 900 feet high and 3,000 feet across the base. Above, a Paramount comera crew, working on moving lava, shoots background scenes for Cecil B. de Mille's "The Story of Dr. Wassell"



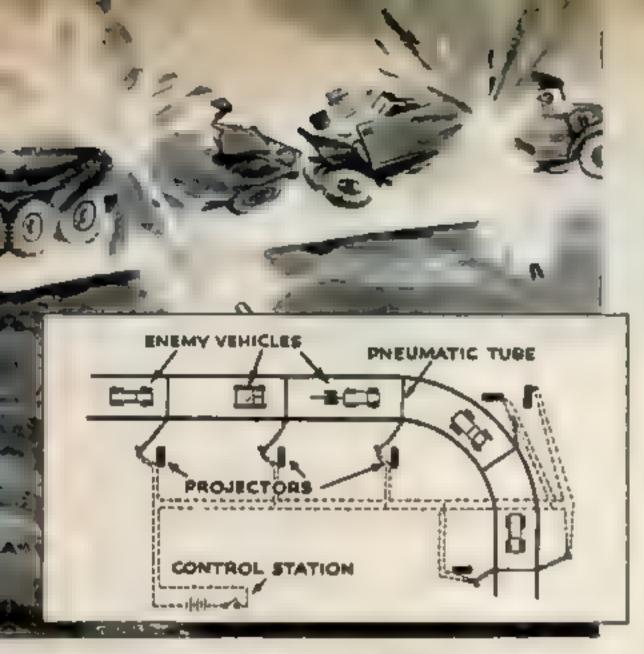
A HIGHWAY-DEFENSE system blows up long lines of enemy traffic or stays its fire-power when friendly vehicles are passing, according to the plan of Clyde B. Cox, Fort Ord, Calif. Strips of pneumatic tubing—like

those that signal filling-station attendants are laid across the road and connected with mortars concealed along the sides. When enemy cars enter the zone, a switch is thrown at a remote station. As the pneu-



CREW SITS ASTRIDE LONG FUEL TANK

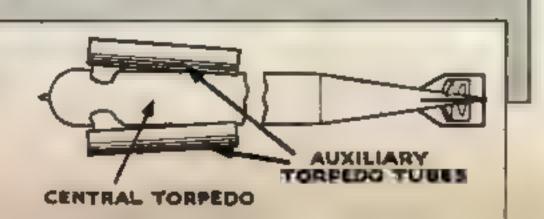
amphibious tank presents a poor target for the enemy's armor-piercing projectiles. Byron Q. Jones, Fort Knox, Ky., designed it, departing from conventional types by placing the engines in detachable units on either side of the central compartment. Seated in tandem in the center, the crew operate the high-speed controls and heavy weapons. Four doors afford them easy-escape should the tank catch fire or turn over.

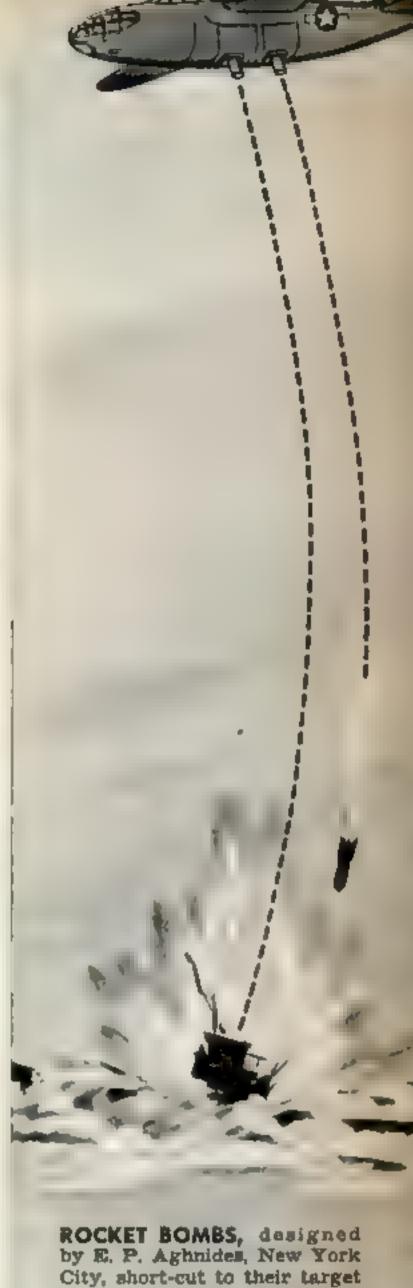


matic tubes are depressed by the rolling wheels, air pressure fires the guns, and each unit of the column is methodically blasted. This system can be installed quickly, eliminating the lengthy job of digging up the road to lay land mines.



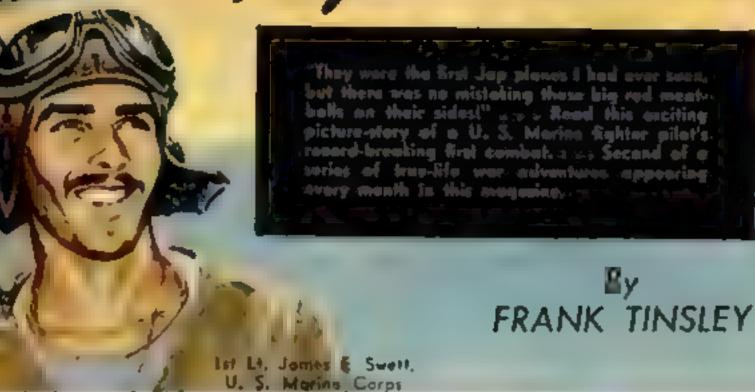
A TRIPLE EXPLOSIVE to be launched from planes and ships has been patented by George Wise, Brooklyn, N. Y. With the aid of a time-control mechanism, a mother torpedo gives birth in flight to two auxiliary torpedoes, which strike on either side of the main burst.





ROCKET BOMBS, designed by E. P. Aghnides, New York City, short-cut to their target in a vertical line. Momentum gained from the propelling charge counteracts the acquired speed, so that, instead of falling with the usual curved trajectory, the bombs drop almost straight down.

First Fight... Score, Seven



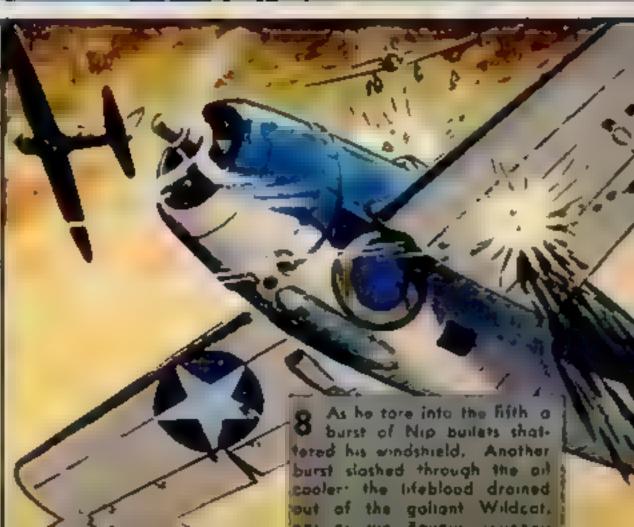


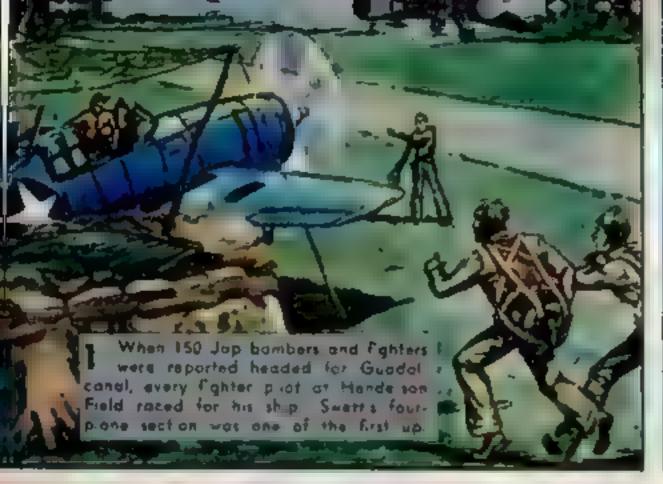
Congressional Medal of Honor

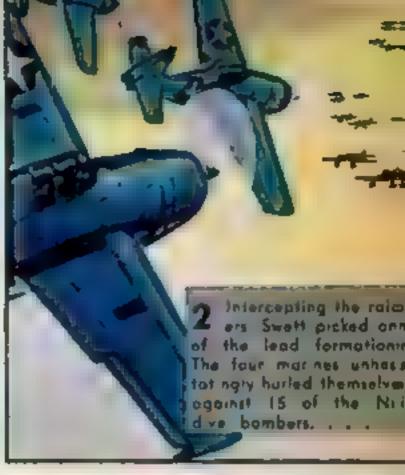


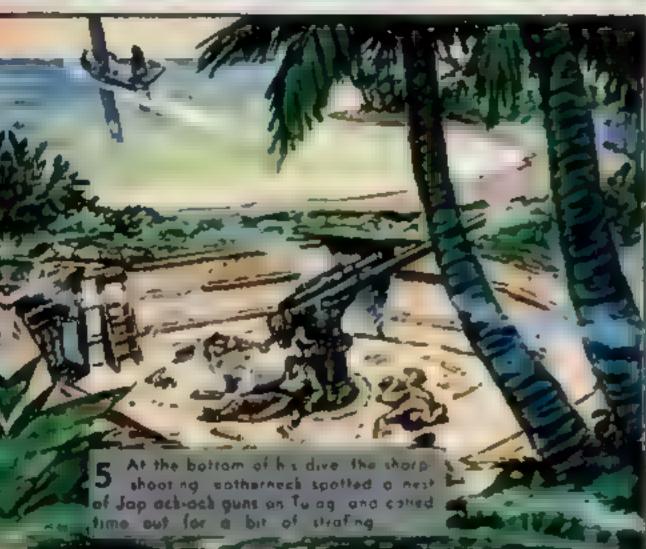




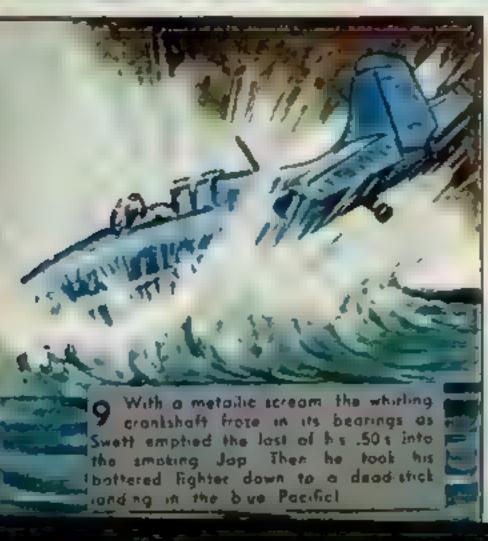


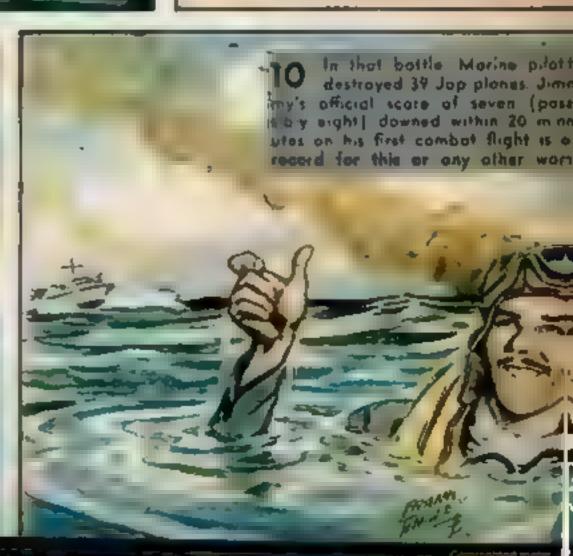












Invisibility Unlimited

Army laboratory tests show how well camouflage paints will work in actual combat.



To test their weather resistance, points brushed on wood, metal, and fabrics are placed in this drum where, in two weeks, carbon ares and water jets give the points the same sun-rain exposure that they would get in six months of actual use



The first thing comouflage point must do is hide what is underneath. Here six cc. of point is being applied to a square foot of checkerboard to see how effectively it hides the black squares

A series of rigid laboratory "trials" that test camouflage paints under conditions simulating those that they will encounter in actual usage have been developed by Army engineers at Fort Belvoir, Va. Prime requisites in the paints that will be used to hide military equipment from the enemy on every front from Alaska to the Aleutians are: durability, hiding power, resistance to fire, and the ability to retain their hues under extremes of heat and moisture. Shown are some of the ingenious methods by which paints are tested for these qualities.

Objects carrying paints are also put under a stream of water and rubbed 500 times with a stiff brush. If 50 percent of paint is lost, it is rejected

Shrimp netting to which test paint has been applied is held at a 46-degree angle over a vertical flame burning 3/10 cc. of anhydrous ethyl alcohol. The dimensions of the hole that is burned in the net determine the paint's resistance to fire





By ANDREW R. BOONE

Were you to look down on California from skyways high over San Francisco's Golden Gate, you would see on a clear day a gigantic mountain-rimmed bowl out of which engineers are fashioning a food basket of fabulous promise for hungry postwar populations. Almost as large as Belgium and Switzerland combined, and abounding in fertile soil, this great eggshaped bowl alone may produce enough food to feed 70,000,000 people. It needs but one thing, however—the gigantic and ingenious irrigation system that is now in the making (P. S. M., June '40, p. 47).

Your aerial view would provide some idea of the size of the engineering works that are required to do the job. Stretching before you would be 22,500 square miles of land cupped between the Sierras and the coastal mountains. This is California's Central Valley—a farming empire that in the past has been ravaged alternately by floods and drought.

When the \$500,000,000 irrigation system swings into full operation, it will hold back water with one hand and distribute it seasonally and geographically with the other

FOOD for 70,000,000

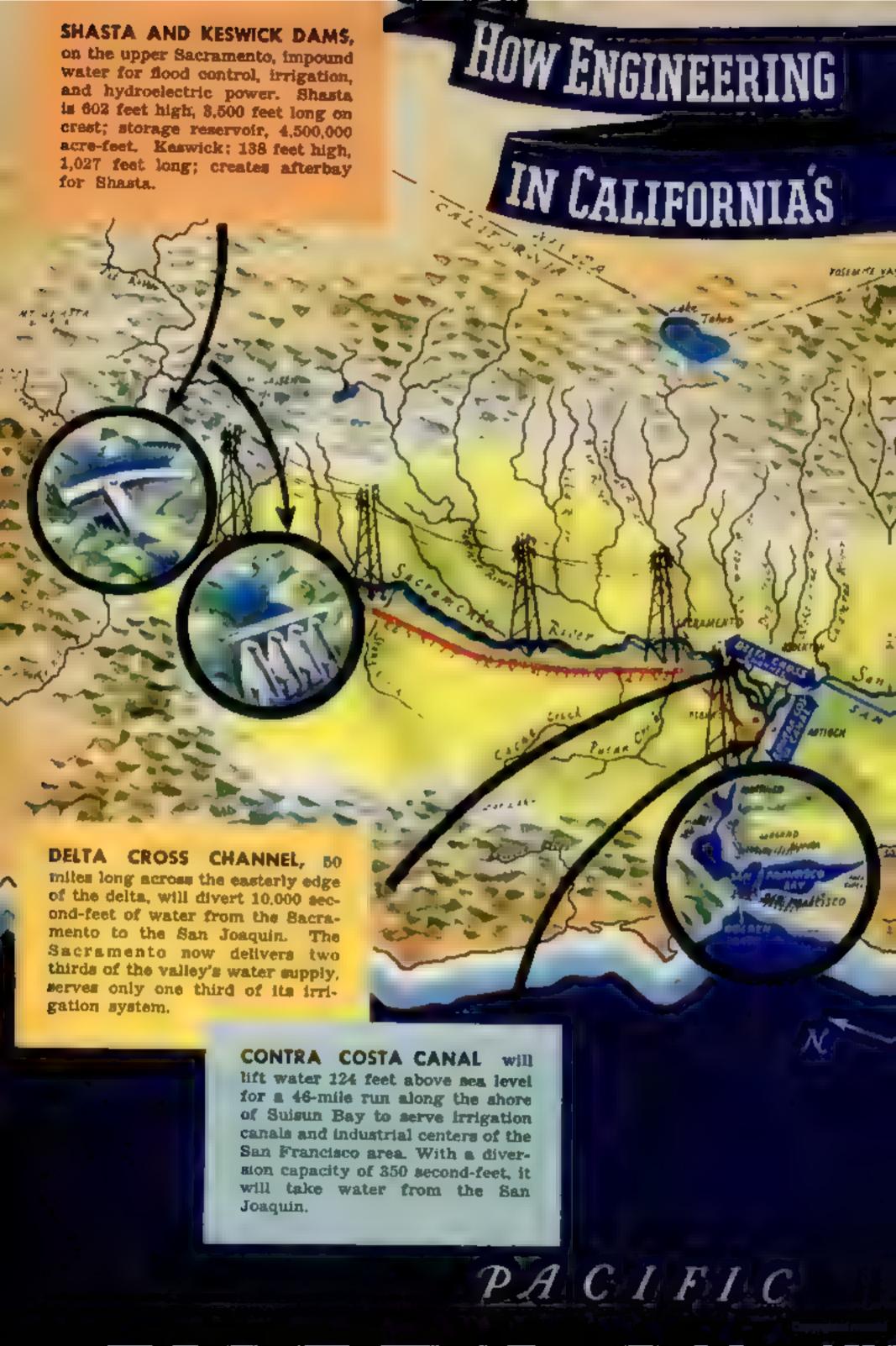
Rivers run uphill to create a 22,500-square-mile victory garden nearing completion in California's Central Valley.

To the irrigated \$ 000,000 acres in that area which today yield good crops will be added twice as many more, with food-growing potentialities that will stagger even those accustomed to thinking in global terms.

Let's look at a few specific sims in the daring scheme. It proposes to drive from central California, as (Continued on page 98)

One of the big jobs in irrigating California's Central Valley is to transfer water from the Sacramento river to the San Joaquin at the rate of 4 000 000 gallons an hour. Once canals are completed, the thousand Mt Shasta 600 miles away, will help water forms and cotton fields (below) in the Fresno area Photos by D B Bureau at Recipmenton









Contra Costa, one of the main canals of the system, brings water from Rock Slough to the forms, cities, and war plants that lie east of San Francisco

far inland as Sacramento and Stockton, salt water which backs up 100 miles in periods of low river flow; divert from the Bacramento River into a 50-mile-long canal a great stream of water, transfer it to the lower San Joaquin River Valley, lift it 125 feet into another canal, and transport it 110 miles, create 24 surface storage basins and build flood-control dams for a score of untamed waterways; carry water to far-flung ranches in 395 miles of canals; create new resources of hydroelectric power at Shasta and Keswick dams; store in an extensive system of natural underground reservoirs 7,500,000,-000,000 gallons of water which farmers may use to irrigate their land, and extend year-round navigation up the Sacramento to the big food center of Red Bluff.

These are all in the master plan. Working them out are engineers of the U. S. Bureau of Reclamation—charged with placing the Central Valley project in operation as soon as possible—and state engineers who are developing a water plan for California as a whole.

Your aerial panorama would also show you how it is coming along. In the distance you would note a quintet of canals, their smooth contours contrasting markedly with meandering streams. Friant-Kern Canal will slash the southeast corner 160 miles from huge Friant Dam, with its stor-

age capacity of 170,-000,000,000 gailons. Madera, siready in operation, cuts 37 miles north from Friant to The San Ash Creek. Joaquin pumping system will are 100 miles around the west side from Tracy to the San Joaquin, near Mendota. The 50-mile delta cross channel will bring northern water to the south. Contra Costa carries fresh water from Rock Blough to farming and industrial communities as far west as Martinez, at the lower end of Suisun Bay.

Near at hand, you would perceive a great heart-shaped storage basin, its point at Pitte-burgh, its upper reaches touching Sacramento and Stockton. This basin, whose 500 miles of sloughs and streams interlace 400,000 acres of

rich farm land, holds the key to the great transformation of California's agriculture, But a question perplexing engineers is how to drive salt water downstream from the delta pool and transfer fresh water from the Sacramento River Valley in a single operation.

Basically, the problem represented by the Central Valley arises from the fact that two thirds of the water reaching the sea flows down the Sacramento, which serves only one third of the valley's acres; the other third, coursing down the San Joaquin, must serve two thirds of the total acreage. It is for this reason that tremendous quantities of water are to be carried south into the San Joaquin, where they will be dumped into the Mendota pool.

Engineers believe they also have the answer to the problem of depleted underground water supply. Throughout an area 100 miles long, between Fresno and Bakersfield, water will be turned from the Friant-Kern Canal to spread over porous beds of dry streams and abandoned acres. As it seeps through sand, clay, gravel, and atone, pressure and flow combined will raise the level of wells scores of miles distant. Even the 24 major reservoirs that loom large on the blueprints of the mammoth project are expected to hold less water than the great subterranean storage tanks.



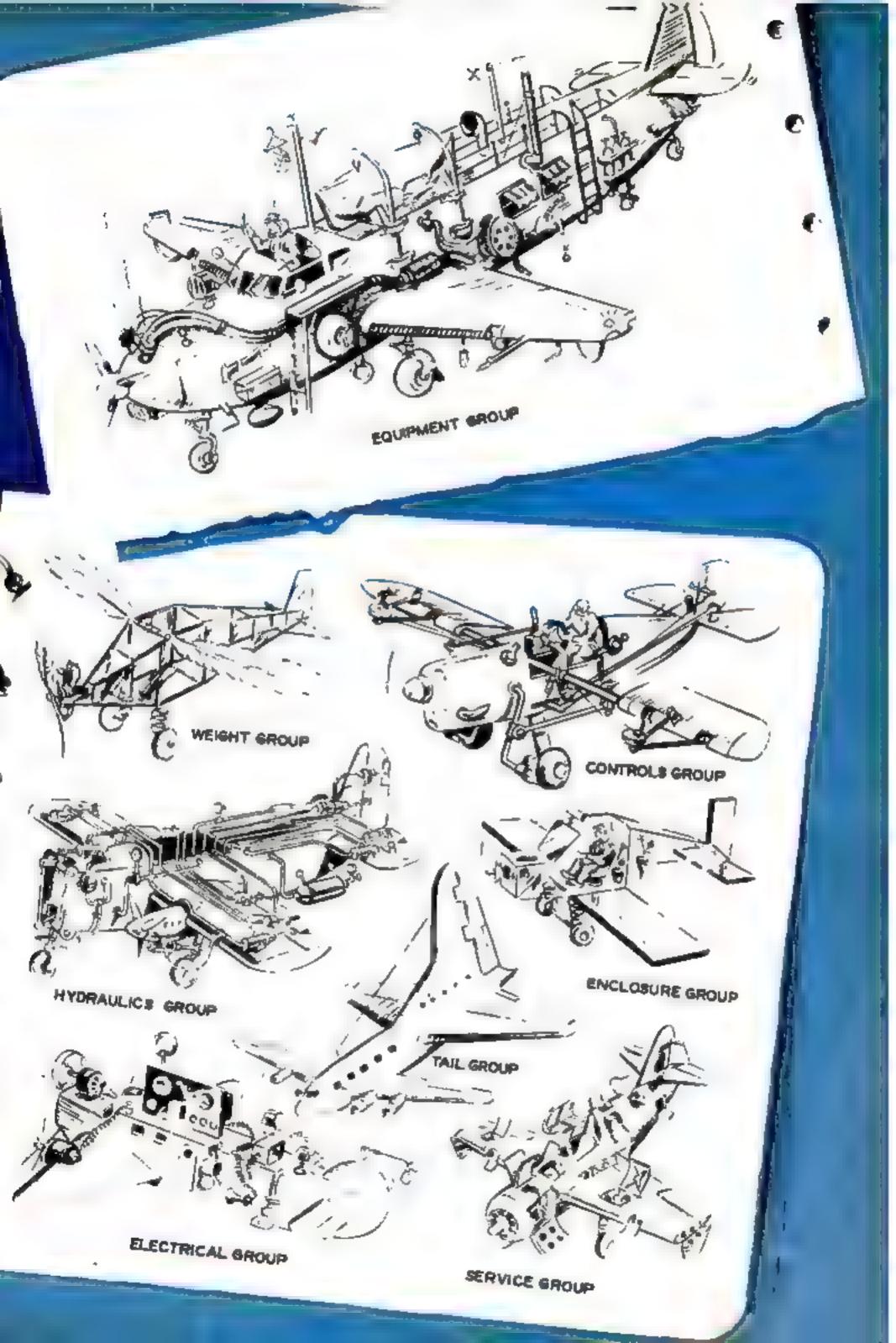
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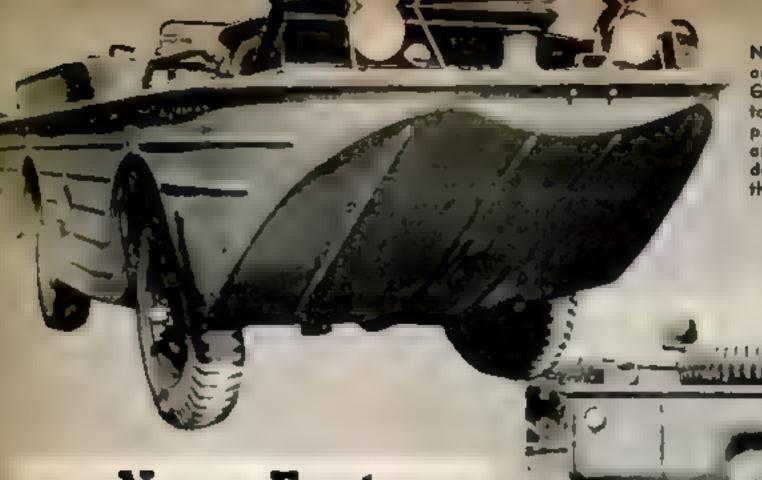
empeanage group, all tail; and so on



WING GROUP

AERODYNAMICS GROUP





Now a veteran of action on many fronts the Army's GPA amphibian quarterton (P.S.M., June '43, p. 74) is familiar to friend and fae. Here are some details of its construction that can now be disclosed

New Facts ABOUT THE

Seagoing Jeep





Rear view (top) shows rudder and propeller. The rudder wags when the steering wheel is turned. Above: adjusting hinged surf shield at the bow

If the starter won't work, the engine can be cranted by hand through a part, as shown below



that regulate air flow

Four lifting eyes provide hoisting holds. One is shown at left with its cover removed



Spiders Spin for War

NLISTING spiders in the war effort is the business of Mrs. Nan Songer, of Yucaipa, Calif, Hairs, some as fine as 1/500,000 of an inch, are used in many kinds of precision instruments, and to meet wartime demands Mrs. Songer makes the gossamer threads of spiders available to industry. The spider is fastened to his work block of yucca. wood; tickling his nerve centers stimulates him to begin spinning. As the thread comes from the spider, it is wound directly onto a steel frame. The silk, a quick-drying secretion from microscopic abdominal glands, varies in size with the age, sex, and type of the spinner. Among Mrs. Songer's workers are polsonous black widows.

As the spider spins it, the delicate silk is wound directly onto a steel frame, which is then set aside for the threads to dry. Below, three of the spiders—fastened with hairpins—are put to work on one block, which makes it easy for Mrs. Songer to keep close watch on them

Photographs by SEN WHITE

Twelve frames of the silk, each of them secured to protect the thread, are shipped in specially made bases

Because spiders are cannibols, each must be given a room of its own for leisure hours. Mrs. Songer gives both housing and diet her special attention







WAR LEAVES ITS MARK ON THE

The Coast Guard has a big job in maintaining our lighthouses, buoys, and other navigational aids under wartime pressure. SIGNPOSTS
OF
THE SEA

By ALBERT Q. MAISEL

Photographs by ROBERT F. SMITH

N TIME of peace, the U.S. Coast Guard maintains thousands of aids to navigation - lighthouses, lightships, radio beacons, buoys, and channel markers-up and down our coasts and in Alaska and our other possessions. With the war, this division of Coast Guard work has doubled and redoubled, taking on new importance and new dangers. In distant harbors all over the world, the Coast Guard has had to survey and mark channels, harbors, and mine fields, its men working in frequent danger of submarine or air attack from the enemy. In our own waters, also, its job has doubled as shipping has increased by leaps and bounds and as harbor-defense works have introduced new hazards to navigation.

Basically, the job of all navigation aids is to guide ships along the coast and into our harbors by warning them away from dangerous spots. In peacetime, such dangers are presented by rocks, shoals, wrecks, and similar obstructions. In wartime, there are the added complications of mine fields, antisubmarine nets, and new anchorages required by

WAR POSES PROBLEMS IN NAVIGATION AIDS



REFLECTOR BUOY. Giving out no light, this buoy affers no help to the enemy, but its band of reflecting material glaws brightly in the beam cast by a friendly searchlight



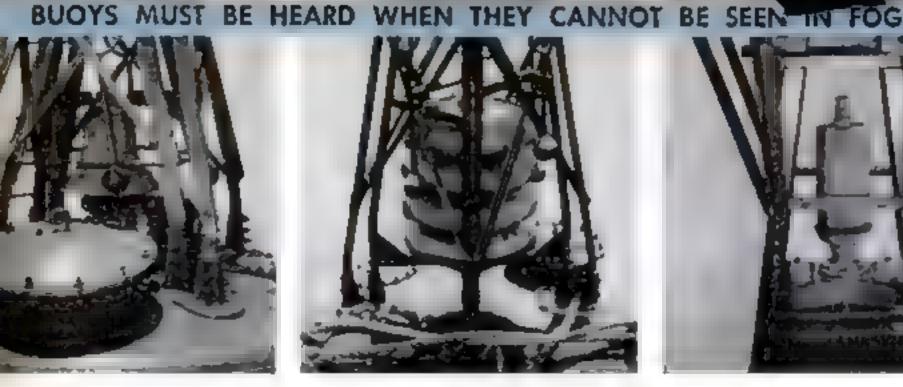
TILTED BUOYS, such as those supporting submorine nets, carry on ingenious mechanism that keeps the morking light upright to project its rays horizontally

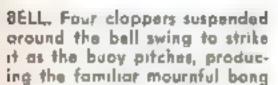
COLLISION takes a heavy tall among budys in wortime, owing to floating mines, weekage, and navigators unfamiliar with their harbors. Here Lt. H. V. Pederson, veteran Coast Guard officer, examines a casualty

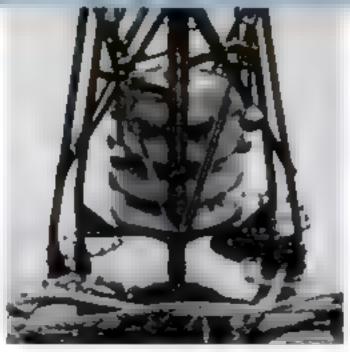




Shining up a safeguard of the sea: A Coast Guardsman polishes the lenses of a buoy that has been reconditioned for another six months or so of service in guiding mariners to port







GONG BUOY gives out a chime signal of four notes easily distinguished from a bell buoy. Each of the four gongs has its own chapper swinging independently



WHISTLE, Wave action generates air pressure, which is controlled by a specially constructed valve to make a low, earle, whistling sound

convoys at their points of rendezvous. Many of the devices used by the Coast Guard are swathe i in secrecy Should their details fall into the hands of the enemy, they might aid submarines to destroy whole convoys of our ships But the Coast Guard, and all navigators still place their greatest reliance upon such devices as lighthouses and buoys, whose basic principles were developed long before the war, but whose operation has been modified to meet wartime conditions

At the outbreak of the war, there were more than 17,000 buoys in use along our coast; today, this number has been substantially increased. Buoys differ widely in size, shape, and type, and each has its special significance and meaning to the mariner,

As a ship comes toward a harbor, the navigator steers a course between two buoys which mark the entrance to the channel, a conteal red 'nun' buoy marking the right-hand margin, a cylindrical black can" buoy marking the left. These may be located far out to sea, but once the mariner has found these buovs his course is clear, for always within sight or sound will be the next pair of channel markers. until he has found his way to a dock or safe anchorage. Buoys with red and black horizontal bands indicate obstructions or channel junctions

Other colors are used for special purposes.

THIS IS HOW A DAMAGED BUOY IS TAKEN UP FOR REPAIRS AND

This lighted gong buoy has been reported listing so that its light cannot be seen from the seaward run of the channel, into action goes a specially designed Coast Guard tender equipped with a derrick for lifting the big. heavy markers aboard. On the deck of the ship, seamen scrope through a year's accumulation of barnacles to diagnose the trouble

With its steel body stove in, the budy must go to the repair yard for reconditioning, while a replacement is left in its stead. The damaged marker gets a complete overhoul, which includes scraping off the bornacles, pointing, and inspection of all mechanical parts. The Coast Guard repair yards, located at strategic points along our coastlines, have equipment and personnel for doing this work with the utmost speed and efficiency







SINKERS made of concrete replace anchors of scarce steel for maoring buoys. Each of these heavy blocks is capable of holding even the largest buoy in place against the pulling of wind and sea in any weather

White buoys mark anchorages; yellow ones, quarantine anchorages. A white buoy with a green top signifies an area in which dredging is being carried on. A black and white, horizontally banded buoy marks the limits of areas in which fish nets or traps are permitted.

A large proportion of all buoys carry lights so that they can be seen by mariners at night. Here again color is important, green lights marking the left sides of channels as you go in, and red lights the right sides. To further facilitate identification, flashing lights are often used so that the navigator, in the dark of night, may distinguish one buoy from another, or slowly flashing lights indicate the regular channel markers.

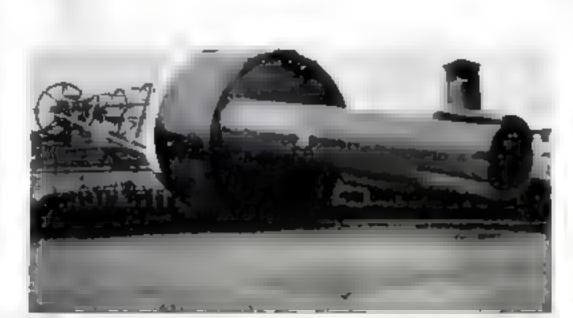
Quick-flashing lights-60 or more flashes



MOORING. A heavy chain tethers the buoy to its sinker resting on the ocean floor, while a counterweight keeps it upright. When water is deep, large buoys must be used to support the weight of the lang chain. Pockets in the buoy body hold cylinders of gas far the light

PUT BACK INTO THE SEA

Fresh and clean in its new coat of point, the rebuilt buoy awaits a new assignment in a storage yard. When it goes back to sea, its correct position is checked carefully by an officer on the tender, who takes bearings on landmarks. When the exact location is found, the sinker goes averside, followed by the buoy itself. Its pockets filled with fresh gos cylinders, it is ready for another long tour of duty guarding the safety of seaforing men







LIGHTHOUSES are no longer the lonely places they used to be. Augmented crews now man them to watch for enemy activity and operate the many devices for protection of wartime shipping. Many lights use commercial power

per minute—are placed at sharp turns or sudden constrictions of the channel and call for special caution. If the light consists of quick flashes interrupted by dark intervals of about four seconds between flash groups, the navigator knows that he is heading toward some obstruction or a junction of channels. Short and long flashes alternating mark the center of a wide channel, and tell the navigator that he should pass close to the buoy for greater safety.

While lights on buoys facilitate nighttime navigation in good weather, sound is utilized to achieve a similar end in fog or storm. Thus, lighted and unlighted buoys at important points are equipped with whistles, bells, or gongs operated by the motion of the buoy in the water.

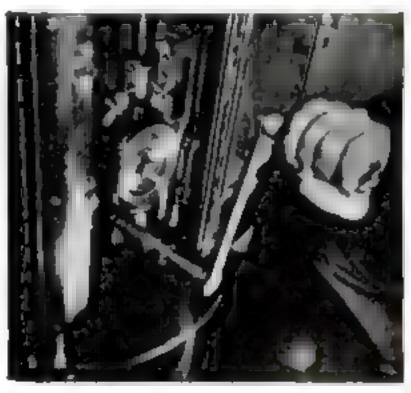
More than 107 types of buoys have been developed to cope with differing conditions met at various buoy locations. Very large buoys must be used in deep water to support the long chain which connects the buoy to its anchor on the bed of the sea. Smaller, extremely rugged units are moored in rough, shallow waters, and are designed with low centers of gravity to remain nearly upright despite the heavy pitching of the waves. Broad, round-bottomed buoys are used in shallow waters. (Continued on page 191)

A BELL supplements
he light when a fog
ets in at the station.
t is rung by a spring
nechanism that is
vound each holf hour



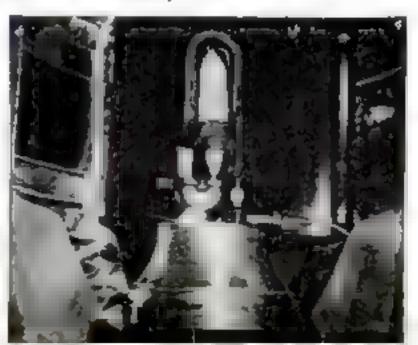


FUEL. Whatever the regular light source, auxiliary or stand-by equipment must be on hand for emergencies. Here a keeper tests his auxiliary supply of gos for the light

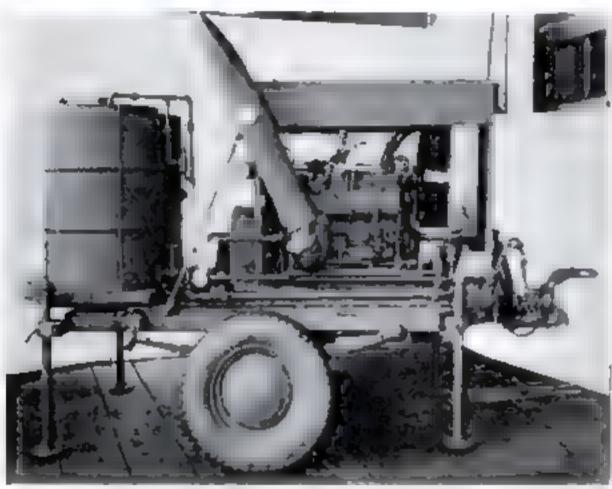


ROTATING LENSES must revolve at a conetant, predetermined speed to produce the accurately timed flashes that distinguish the lighthouse from others along the coast. They are turned by a clockwork mechanism which is wound up every four hours

A WELSBACH MANTLE, heated to incondescence by a gas flame, is a common source of light. Its rays are greatly magnified by lenses for visibility from far out at sea







FUMES from a new smokescreen generator developed for the U.S. Navy by the Chrysler Corporation quickly blanket land targets from the enemy. Mounted on a trailer, it is towed around as required by shifting winds. Oil circulates in the fluid drive of a six-cylinder automobile engine, where it is preheated to high temperature by the racing motor. Atomizer nozzles feed the bot oil into the exhaust manifold of the engine, where it turns to vapor and is discharged from a stack. Two 55gallon tanks carry the oil.

PLASTIC BOARD, half the weight of aluminum, has been developed for structural uses in warplanes. Shown at right, it does not shatter when pierced by a bullet, and may be cut and bent into innumerable shapes. It finds principal application in supports for bullet-sealing fuel cells.

OLD RAZOR BLADES, clamped two at a time in the jig below, slice cardboard tubing, fed from right, into segments. Chemically treated, the slices serve as insulation in miniature motors.





POPULAR SCIENCE

new ideas from the inventors



The General Gets His Map

TOPOGRAPHICAL ENGINEERS PERFORM A 20-HOUR MIRACLE TO CHART THE PATH TO VICTORY IN FAST-MOVING ATTACK

By JACK O'BRINE

Photographs by William W. Morris

RECONNAISSANCE radio flashes the news. Retreating enemy forces, hard-pressed on the flanks and pounded in the middle, have blown up the great bridge, cutting off pursuit by our armored division. It could be a serious setback. But let s

see how an American general will handle it.

Minutes after receiving the news, the
general dictates an order. It's a curious
order. He doesn't want assault boats, bridge
repairmen, or amphibious jeeps. He wants
a map—a particular kind of map—at once.

To the rear, in carefully camouflaged operational position, topographical engineers await just such an order. The boss of the outfit is an alert young lieutenant. His

FLIGHT PHOTOGRAPHS ARE ASSEMBLED TO FORM THE MAP



- At Topo headquarters, averlapping air photos made by a reconnaissance pilot are fitted tagether and taped to form a mosaic map of area
- 3 A draftsman lays out grid lines by constructing perpendiculars to the base line. Grid divides man into squares enclosing equal areas





- 2 Moistened prints are "feather-edged," or torn with ragged edges, so they will poste together smoothly without conspicuous lines
- 4 Place names and other information must be inked in on the mosaic. A mechanical lettering set with rulerlike template speeds job

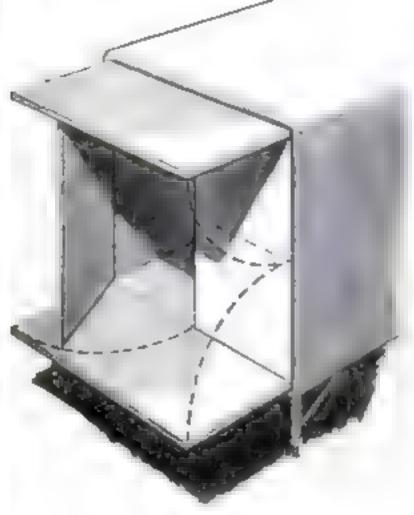




TRIMMING NEGATIVES. After the patchwork map has been photographed in the camera truck, the negative is trimmed to the size of the positive reproduction plate and stripped. The men work on a glass table lighted from below



RETOUCHING is done on the negative with apaque point. From here the negative goes to the map-reproduction trailer, where a zinc plate is made from it. The plate is then placed in the Harris lithographic offset press, which rolls off 20-by-22½ sheets at the rate of 5,000 on hour to supply units involved



Compact, mobile equipment helps the Army's map-making magicians work their miracles. The rear of the darkroom truckcan be opened out, as above, and covered with a tarpaulin to give more space

company functions like a miniature battation. It has three platoons—one for field survey, another for camera-reproduction work, and the third comprising computers, draftsmen, and photographers. They are all alert for the call that comes clicking into the command-post tent.

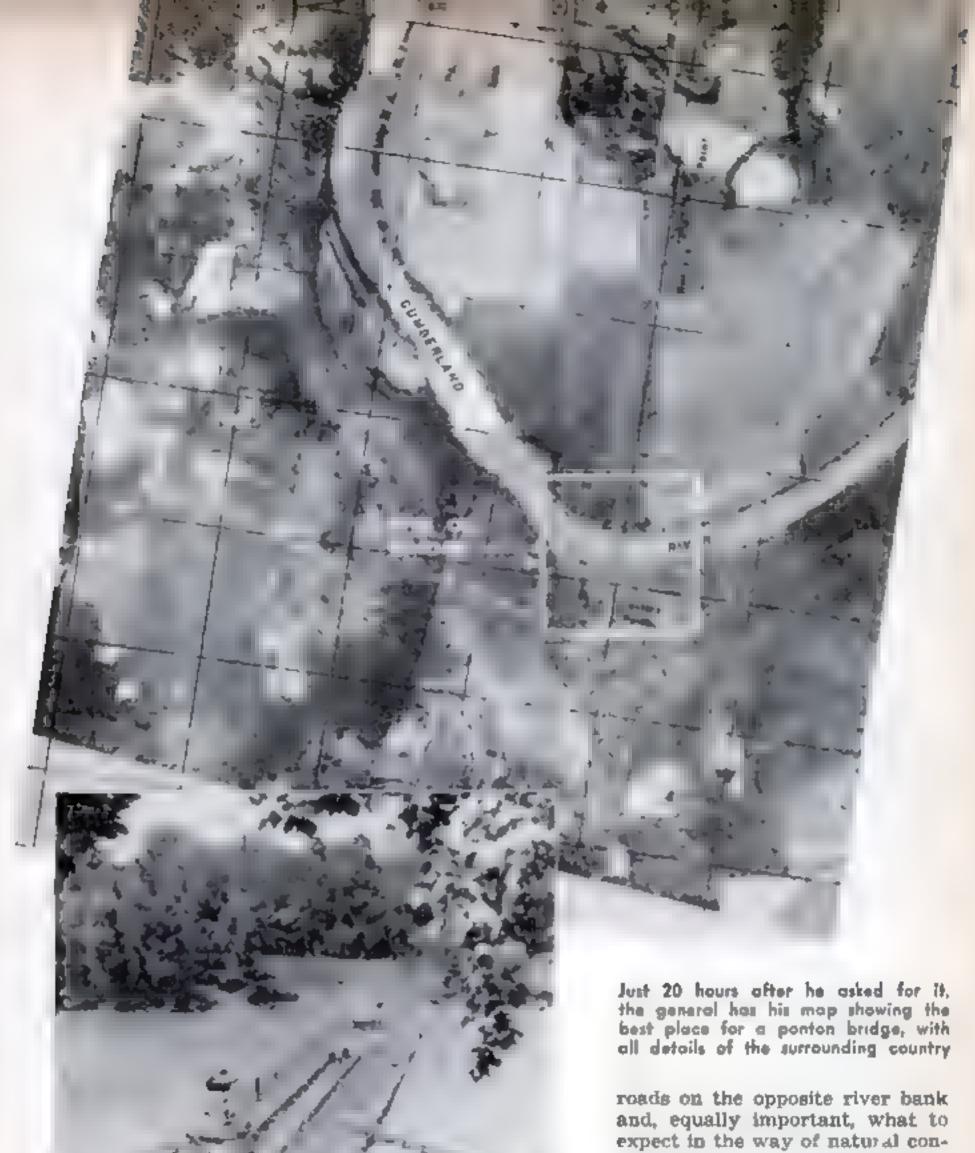
It reads: "Rush photo map HP-C area showing bridge site and vicinity both sides river. Prepare 5,000 copies immediate delivery our units here."

The lieutenant immediately puts through a request to air-support command for aerial photographs of the area.

At air-support headquarters, a young reconnaissance pilot is assigned to the mission. He's off in a cloud of dust, and soon his automatic, oblique-set camera is clicking sequence shots of the bridge area below. He lays his course carefully, shooting the area in strips as he flies back and forth. A 60percent overlap is allowed on each strip to give the map makers plenty of prints to work with. "Shooting" completed, the pilot stuffs the film into a tube and lets it parachute down over "Topo" headquarters.

Map makers are waiting. This is where they go to work. Their step-by-step progress is shown on these pages in pictures and drawings. The miracle: Less than 20 hours after the general's order arrives, 'le topographical engineers have placed in their commander's hands a slick, 20 by 22½-inch mosaic of the bridge area, and 5,000 copies have reached the units concerned. Should more be required, they can be run off at the rate of 5,000 an hour.

But why the map? It's the general's key to future operations. It tells him at a glance the safest, most practical point at which to fling a ponton bridge across the stream. It shows him the exact width of the river at that point. Revealing the position of the enemy with relation to this operation, the map indicates how much armed protection will be necessary. It shows the situation of



Another order throws the combat engineers into action (P.S.M., Dec. '43, p. 86). Three more hours, and our armor is rolling across the river on the new pontan bridge

roads on the opposite river bank and, equally important, what to expect in the way of natural concealment for assault troops establishing the bridgehead. With the map before him, the general knows just what to do to overcome the temporary advantage achieved by the enemy in blowing up the big bridge. His orders rattle off—and, only three hours from the time he received the photo map, our armor goes pounding across a new bridge to take up the pursuit of the enemy. Constructed of pontons and steel, the bridge can be built to span as much as 330 feet of water.

MARCH, 1944 113



"BABY FLAT-TOPS" that have been constructed by the Kaiser Shipbuilding Company are now being used by the U.S. Navy as escort vessels in the various theaters of

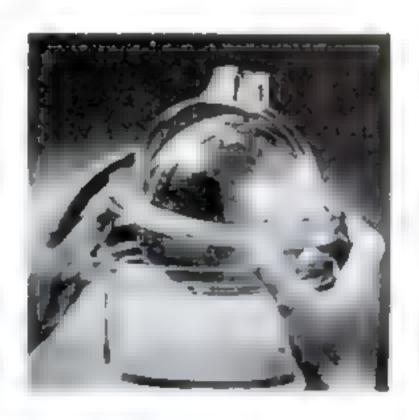
naval operations. The above photograph, which is the first to be released, shows one of the new small aircraft carriers of the Casablanca class.

A WORLD GLOBE incorporating a celestial aphere that shows 22 navigational stars has been designed by F. H. Hagner, of San Antonio, for celestial navigation in life rafts. This one-pound

Plexiglas instrument eliminates the need of a sextant, compass, and almanac.



KNITTED WOOLEN CAPS carrying visors and ear flaps are being issued to American soldiers stationed in temperate zones. The snug-fitting cap can also be worn under the regulation steel helmet.





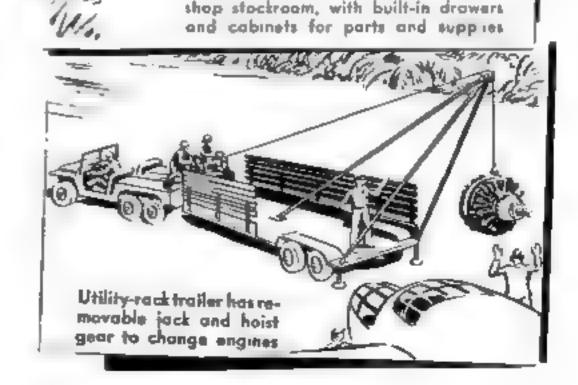
POISON GAS by the tankful lies waiting to be packed into Allied bombs and shells should the Germans resort to this barbarous instrument of war in a final desperate effort to stave off defeat. Shown at the left are only a few of the thousands of cylinders of poison gas that are being held in readiness at eastern U. S. arsenals, Should the occasion arise. Germany could be quickly outfought in this type of warfara by virtue of Allied air supremacy.

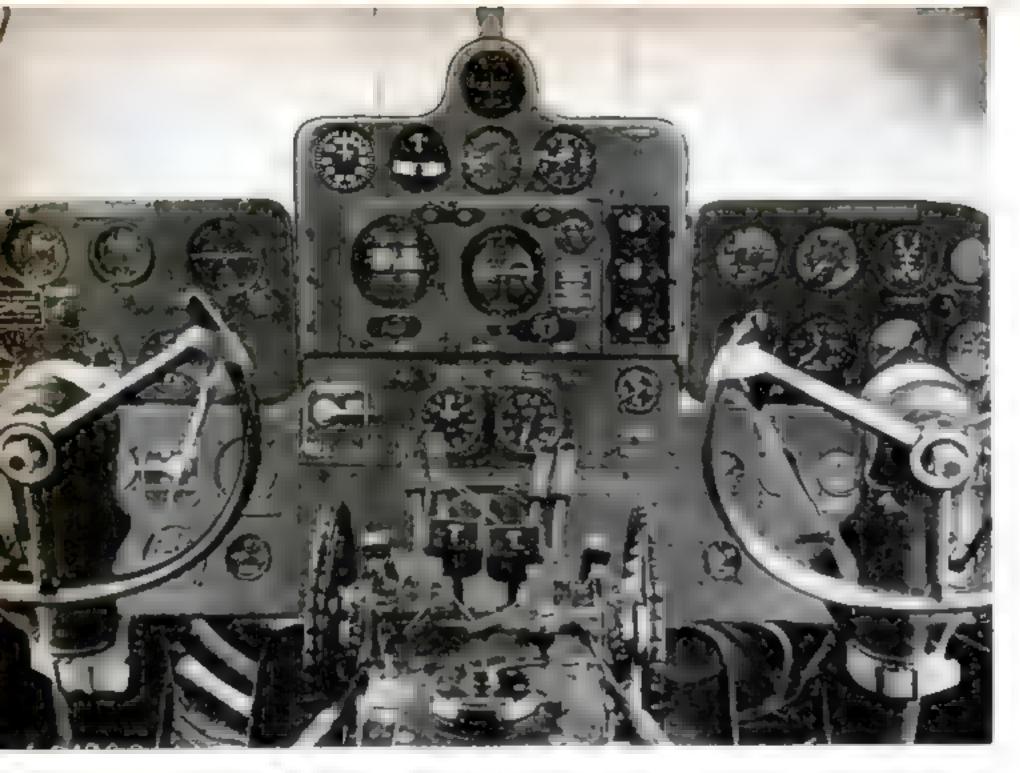


heavy planes over soft ground around landing strips. Flyers ride it to dispersed aircraft.

A van-body trailer serves as a wheeled packing case for delivery of the tug to the front; after that, the tug pulls the trailer as a general cargo carrier or as an ambulance litter carrier. A utility-rack trailer has detachable hoist and jack fittings for changing engines in planes. A technical-supply trailer carries plane parts and supplies in built-in drawers and cabinets.

Sixty-five percent of the tug's parts are interchangeable with those of the ¼-ton truck (jeep).





The instrument panel of a Curtiss C-46 Commando twin-engine transport. After reading the following article, see how many of the instruments shown above you can recognise

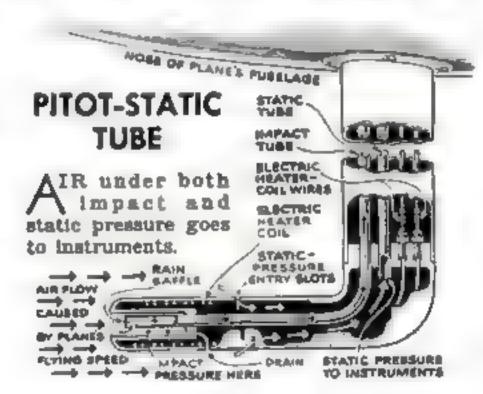
HOW AIRCRAFT INSTRUMENTS WORK

Tireless silent partners of our fighting pilots answer their every question about flight, engines, and avigation.

By JAMES L. H. PECK

Drawings by Stewart Rouse

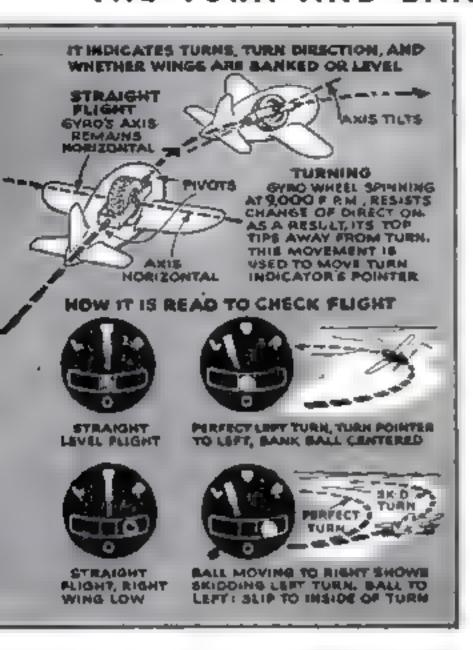
TWO eyes and two ears are not sufficient for the pilot of today's fighter or bomber. In front of him in his cockpit is a somewhat confusing panorama of figured dials whose mute faces give him an amazing amount of information about the airplane he is flying. Some reveal the pulse and respiration of the big power plant; others guide the flyer



through darkness and fog which even the keenest eye could not pierce; still others indicate the position of the plane and how it is behaving in flight under conditions in which the airman's senses would only trick him into serious error. Perhaps the most remarkable of all is a gadget—in reality a combination of three instruments—that can take over control of the plane and fly it unerringly on the proper course more smoothly than any human hand.

These are precision instruments in every sense of the term. A few of them are preasure-actuated; these measure the weight, elasticity, or impact of the air surrounding the plane and translate these data, through static tubes or (Continued on page 118)

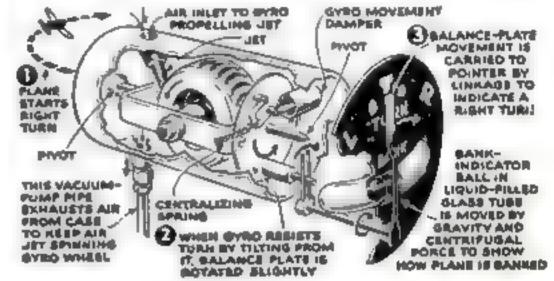
THE TURN-AND-BANK INDICATOR



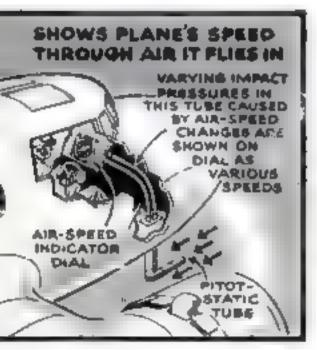
NVALUABLE for blind flying, this instrument corrects errors of the pilot's unaided senses and keeps him from overcorrecting when errors are discovered. The ball that shows bank angle is an improvement over the old pendulum type, which would not work under certain conditions. liquid in the tube keeps the ball from moving too fast. The gyrooperated turn indicator registers angles of turn instantaneously as they are made.



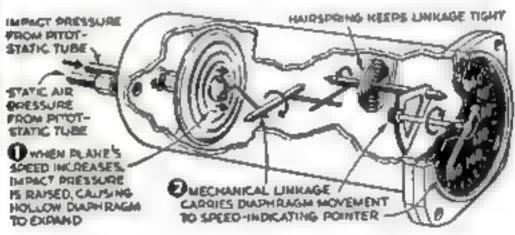
Black ball, shown contored, is moved sight and left by centrifugal force or gravity



THE AIR-SPEED INDICATOR



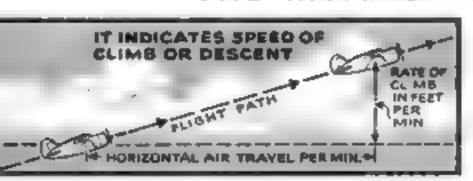
DESIDES warning the pilot of approaching D stalls and dangerous speed in dives, the airspeed indicator helps him in gauging his fuel consumption for his range estimate.



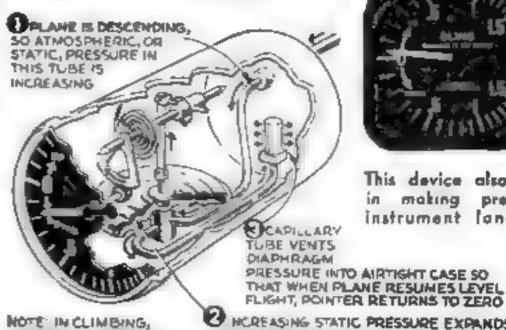


As diving speeds are higher than top levelflight speed of plane, the dial graduations run above the latter

THE RATE-OF-CLIMB INDICATOR



ACTUATED by the Pitot tube's static pilot check on engine-power output, interception of enemy planes, and other factors. It is a key instrument in gliders. As in all static instruments, there is a slight lag in its operation to be considered by the pilot.



DIAPHRAGM SHRINKS AND PROCESS IS REVERSED

This device also aids in making precision instrument landings

HEREASING STATIC PRESSURE EXPANDS DIAPHRAGM, WHICH MOVES LINKAGE SO THAT POINTER INDICATES SPEED DOWNWARD

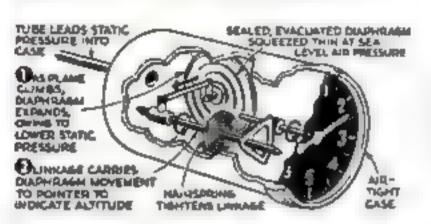
AIRCRAFT INSTRUMENTS

NSTRUMEN

THE ALTIMETER

RANSLATES ATMOSPHERIC PRESSURE INTO ALTITUDE 2 5,000 ATMOS 2992

"SSENTIALLY an aneroid barometer, the altimeter shows elevation above sea level or some fixed point such as the field from which the plane takes off.

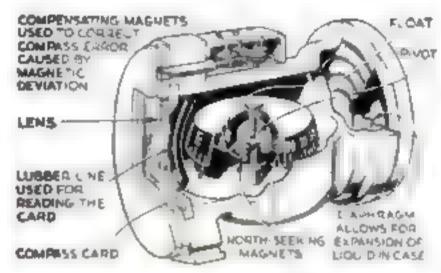




This instrument shows only the height of a plane above the level of the take-off - not distance from plane to the terrain below

THE MAGNETIC COMPASS







A sero must be added to readings: 3 shown above stands for 30 degraes: 33 for 330

OTH of these instruments are governed by the earth's magnetism. The white "lubber line" of the former indicates the direction of the plane. The aperiodic compass employs an arrow to show the plane's direction with respect to the selected course and the earth's north magnetic pole.

APERIODIC MAGNETIC COMPASS

Compass is domped with liquid to prevent dial from swinging too fost



sensitive diaphragms, into readings on the pilot's instrument panel. Some deliver their vital message by way of cables or flexible drives connected directly to the engine. Some depend on vacuum reaction, oil or fuel pressure, or mechanical linkage. A great many are shocked into life when the pilot flips an electrical switch. By whatever means instruments are operated, they must function rehably despite engine and airframe vibrations, despite temperature changes that run the gamut from tropical to arctic, and despite the fact that the plane may be nosed downward in a power dive. lying on its back in a loop, or tipped over on its side in a vertical turn.

To make the maze of dials a little less confusing, sirplane instruments can be divided into three groups: flight, engine, and artyation

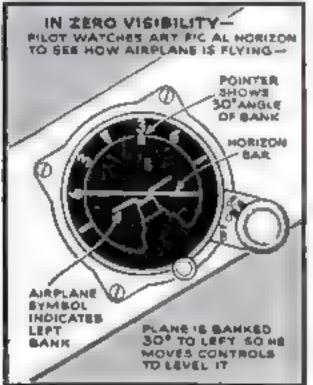
The key instrument of the flight group is

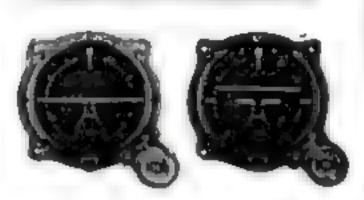
the turn-and-bank indicator, a combination of a gyroscope and a super spirit level. It informs the pilot when his plane turns, the rate of the turning, and whether or not the turn is being made with the proper proportion of bank—the latter being revealed by the position of the ball in the glass tube. The turn hand swings to left or right of a central, vertical position immediately upon the beginning of the turn and stops when the turning action ceases. The speed or radius of the turn is indicated by the distance off center the turn hand swings. This is a pressure-actuated gyro instrument in which a jet of air from a Venturi tube (mounted outside on the plane's fuselage), or an engine-driven suction pump, blows upon a small turbine that spins the gyro.

The air-speed indicator tells the pilot how fast his ship is flying through the surrounding air, by utilizing (Continued on page 121)

THE ARTIFICIAL HORIZON





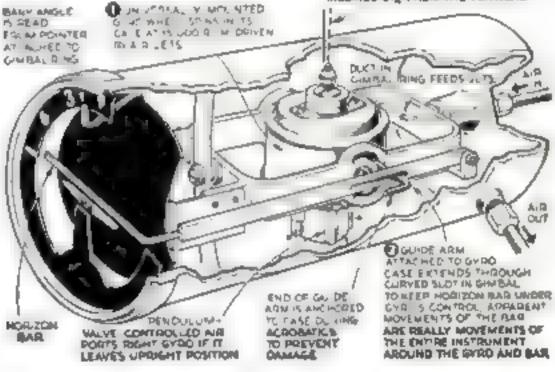


A /HEN the weather makes it impossible for him to see the actual horizon, the pilot must rely on the artificialhorizon instrument to show him the position of his plane. This device acts as an important check on the pilot's senses, for often he will believe he is in a climb when actually he is in a dive. The horizontal white bar, indicating the actual horizon, is kept level constantly by an air-driven gyro. The white marker at the top of the dial is attached to the gyro and remains centered over the horizon bar, registering the angle of bank.



The Sperry automatic harison keeps the pilot opprised of the relation of the plane to the real horizon while the plane banks, climbs, or gudes

DOWNS CLIMBING, BANKING, AND OTHER MANEUVERS DO NOT AFFECT THE GYRD WHICH SPINS WITH TS AND



DIRECTIONAL GYRO INDICATOR



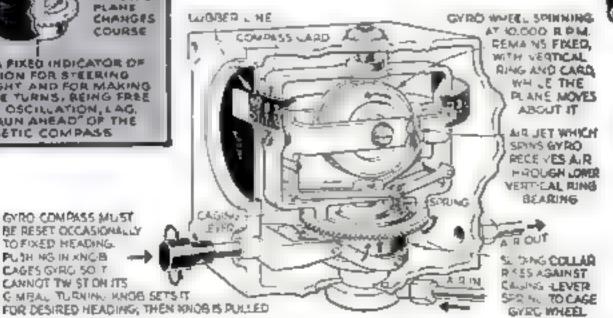
GYRO COMPASS MUST

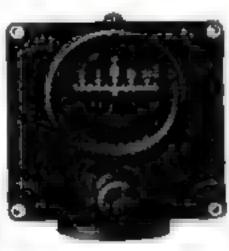
BE RESET OCCASIONALLY TOFIXED HEADING. PUTH NO IN XNOB

CAGES GYRG 50 T

CANNOT TW ST ON ITS

ONSIDERED more dependable than a magnetic type of compass is this gyro direction finder. Locked in its case and turned to the desired compass heading, the spinning gyro, when released, continues to maintain that heading.





The knob shown directly above is used for locking and resetting the indicator. As on magnetic compass (see upper left) the readings lack a zero

AIRCRAFI INSTRUMENTS

TACHOMETER

DIAL

MECHAN SM THIS CAUSES"

WEIGHTS TO SWING OUT, MOVING BOTTOM COLLAR

AND LIFTING PLUNGER

THE TACHOMETER MEASURES

SPEED OF ENGINES CRANKSHAFT IN REVOCUTIONS PER MINUTE

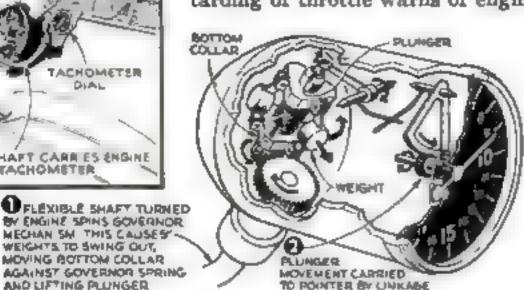
FLEXIBLE SHAFT CARR ES ENGINE TURNS TO TACHOMETER

THE TACHOMETER

URING the engine warm-up period, this instrument advises the pilot of condition of engine via indicated r.p.m.'s. When warmed engine delivers rated r p.m., take-off may be made. In flight a sudden drop in r.p.m.'s without retarding of throttle warns of engine trou-

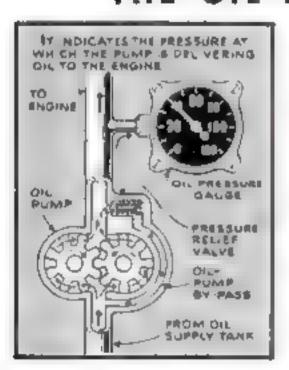


Needle can make two complete revolutions of dial face. This permits the erightest variation in engine's r.p.m. to be accurately recorded

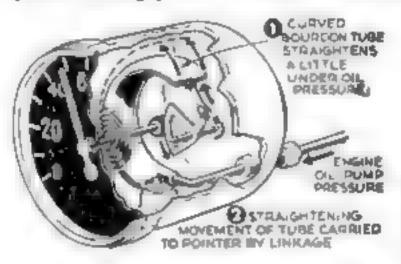


ble, and the pilot should land and locate the trouble to avert serious engine damage.

THE OIL-PRESSURE GAUGE



HIS device indicates the pressure in pounds per square inch at which the oil is being pumped to lubricate an engine's moving parts. One dial is used for

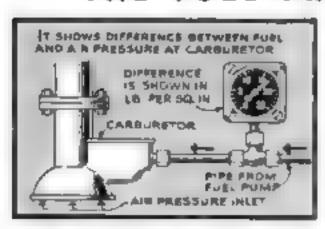




The numbered arrows above give readings for engines 3 and 4 on the storboard wing

the plane's port engines; a second dial for the starboard engines.

THE FUEL PRESSURE GAUGE

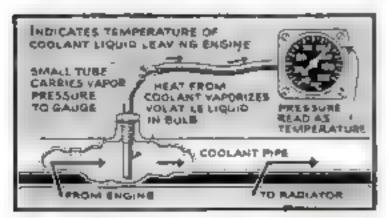


AN ABRUPT drop in this gauge's reading indicates one of three things: the fuel lines are clogged, the supply of fuel is running low, or the fuel tanks have been damaged, as in combat. If the plane is equipped with emergency or auxiliary fuel tanks, the pilot switches at once to prevent loss of power.



Low pressures worn of a diminishing supply

RADIANT COOLER THERMOMETER



"HIS device is found only on planes in which liquidcooled engines have been installed. The volatile liquid in the bulb shown at left is usually methyl chloride. In installing, care must be taken to prevent vibration in flight or any kinks in vapor tube,



Shows temperature at take-off and in flight

both the static pressure (weight of air) and velocity pressure (impact of the air) as measured by a Pitot tube mounted on the wing or fuselage of the plane. The difference between the two pressures moves a diaphragm, and this movement is translated into miles per hour on an instrument-panel dial.

The rate-of-climb indicator (also known as a vertical-speed indicator) enables the pilot to maintain a definite altitude level within a few feet, or to note his plane's climb or descent in terms of the number of feet per minute the craft is changing altitude. This is essentially a statoscope, whose sensitive diaphragm responds to changes in barometric pressure caused by changes in altitude.

The three instruments above may be used alone for blind flying, since they reveal movement and the rate of that movement at the instant it takes place. In instrument-flying procedure, these indicators which form only a section of the flight group, are known as the rate group, and are mounted in a row along the top of the instrument panel immediately in front of the pilot.

The altimeter gives the pilot his height above sea level or some other given point, such as the airport toward which he is flying. It is an aneroid barometer, consisting of a sealed chamber whose sides are flexible diaphragms that are made to move apart or together by changes in the barometric pressures resulting from moving from one altitude to another. The "sensitive" altimeter is refinement that reveals the plane's altitude above any point within a few feet. The "sonic altimeter is the only absolute altimeter, however, and is capable of measuring terrain clearance without previous settings by the pilot. The sensitive and sonic altimeters may also be used to cross-check the rate-of-climb indicator, but cannot serve as a substitute for it.

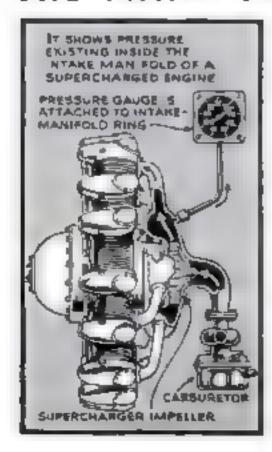
The artificial horizon, like the turn indicator, is an air-driven gyro instrument. It shows the position of the plane in relation to the horizon while banking, climbing, gliding, or performing any combination of these maneuvers. Unlike the turn indicator, the gyro in the artificial horizon is mounted on two axes instead of one.

Its companion instrument is the direc-

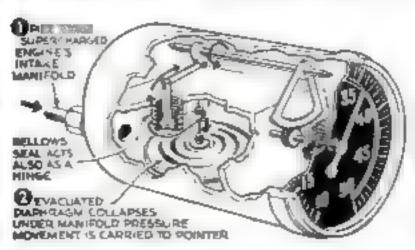
CYLINDER-HEAD TEMPERATURE GAUGE



THE MANIFOLD-PRESSURE GAUGE



THIS gauge is used only on the supercharged engines of planes designed for high-altitude flying. By watching his altimeter as well as this gauge, the pilot of a climbing plane can see if the mounting pressure of an engine's air-and-fuel mixture is keeping pace with his increasing altitude. While a supercharger generally





Dial may be marked to indicate point above which needle must not go at given attitude

increases an engine's horsepower, too much pressure may cause serious overheating. Too little pressure, however, may cause the engine to "die."

AIRCRAFT

tional gyro, a gyroscopic compass that indicates positive direction at all times, registering turns and slight variations in course accurately—which no magnetic-type compass will do. It needs to be regulated only occasionally by the pilot during a flight. The instrument is driven by an air stream from a Venturi tube or an engine suction pump.

The compass was the first instrument used by man for navigating, and it remains to this day the most important on land, sea, and in the air. The aircraft compass is an Indicator of the plane's direction and receives its impulses from natural sources the earth's magnetic field and lines of magnetic variation. The compass card floats in a special liquid called "carnolene," or in kerosene, or alcohol and water. Direction is revealed by a fixed "lubber line" in the face of the bowl. The aperiodic compass, with its entire face visible, and indicating direction by an arrow pointer instead of a lubber line, is coming into universal use. Most magnetic compasses, however, have certain limitations because of errors which science, so far, has been unable to correct completely. The gyro compass is used to cross-check these errors, which are greatest during turns and other maneuvers that disturb the card's floating attitude.

In the palm of one hand, however, may be concealed the secret unit of a new compans, the second to be developed in over 4,500 years, and a great contributing factor to the success of the United Nations' precision-bombing raids. This tiny unit is the triangular coil of the gyro flux-gate compass developed by the Philadelphia Division of Bendix Aviation after seven years' research.

This compass, unlike previous compasses, performs accurately within five degrees of the magnetic poles. Others were inaccurate within 20. It is unaffected by motions of the plane due to maneuvers of flight and rough weather. Earlier compasses spun dizzily. lagged on the turns, or overran in coming out of turns. This compass gives perfectly accurate readings at all times regardless of any change in plane load or of the part of the earth in which it is operating. Previous compasses had to be adjusted to compensate for these changing factors. This required a "correction card" to be posted by the compass at all times, so that the pilot could make corrections as he flew. Several dials may be plugged into the new installation so that as many as five or six separate dials may be observed by crew members, all giving a reading identical with that of the pilot's master dial.

The new Bendix compass consists of three separate units. The first is the transmitter,

which may be located at any place in the plane not likely to be affected by bomb load, accessories, generators, or armor plate. A common location is far aft in the tail. This unit consists of the flux gate itself, a tiny triangular coil held perfectly horizontal to the carth's magnetic field by a small but efficient gyroscope, electrically driven. The gyro and flux gate, attached to the bottom of the gyro mount, are enclosed in a small pear-shaped case attached securely to the plane. From this case, cables run to the second part of the installation, which is merely a radio amplifier used to develop the faint electrical impulses picked up from the earth's magnetic field by the little flux gate held horizontal by the gyro. These amplified signals are sent via cable to the third unit. which is the compans dial before the pilot or other crew member, where these impulses are indicated in terms of direction.

In order to prevent wear and possible damage to the rapidly spinning gyro, which revolves at a rate of 10,500 r.p.m., it is "caged" during violent combat maneuvers. That is, it is locked so that it turns with the plane instead of fighting its movements.

This flux-gate compass, so named because of the function of the little triangular coil as a "gate," admitting and rejecting the earth's "flux" many times a second, has been largely responsible for the great success of long-range bombing raids, where absolute accuracy is paramount.

The four instruments—the artificial horizon, gyro compass, magnetic compass, and altimeter—are known as the amount group in instrument-flying procedure because they reveal to the pilot the amount of movement of the plane.

The Sperry automatic pilot incorporates the horizon and gyro compass and a vacuum gauge, plus a hydraulic system that motivates a set of pistons connected with the control cables of the plane. The two gyro units are air-driven, just as when used separately. One sets the directional course, the other governs up-and-down movement and banking. When air currents swing the plane off course, the gyros, naturally, remain stationary. This relative movement causes small air vents to be opened, and, since the air pressure varies according to the size of the openings (which is determined by the distance the plane swings off course) hydraulic plungers are moved varying distances. This movement, in turn, causes control response through connections with the plane's control cables. The gyro pilot, often referred to simply as "George," requires only occasional adjustment during the course of a flight. It not only maintains the ship in level flight, but can be set to guide the plane in a climb, a glide, a turn, or a

combination of these. It weighs only 60 pounds.

The Bendix autopilot, which differs from the Sperry in that it is wholly electronic, is so much faster in operation and control than manual manipulation that it has practically revolutionized the science of high-level bombing. Designed to give the bombardier the most stable platform possible during the all-important few seconds of a bombing run, the autopilot, by taking over the flying of the plane, checks changes in course almost before they oc-This permits shorter cur. bombing runs and, consequently, less exposure to enemy fire. It also means that hours of preparation and flying are not wasted by slight deviations from the planned course and altitude

American bombing planes have used this electronically controlled device since October 1941. Through its magic operation, many battle-scarred bombers that otherwise would have been lost have returned safely. In spite of great damage to a ship and

even almost complete destruction of the normal hook-up, the automatic pilot keeps the controls still running. The advantage of installing control stations at two or three different points is that various parts of the plane can function independently of the cockpit should it be hopelessly smashed in



THE BENDIX GYRO FLUX-GATE COMPASS, shown on a demonstration mount, uses a gyro-stabilized flux gate to translate the earth's magnetic flux currents into dial readings. This first new compass in 4,500 years is also the first to be absolutely accurate even when used within only a few degrees of magnetic poles

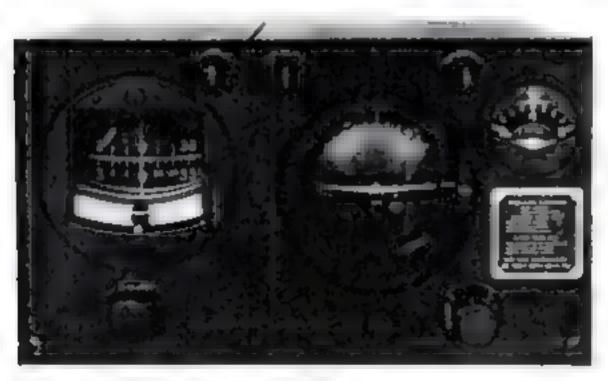
combat. One of the most important wartime developments, the automatic pilot has tremendous postwar possibilities.

Of the engine instruments, the tachometer is in some ways the most important, since it indicates the turning speed in terms of revolutions per minute. The r.p.m.'s, in

turn, advise the pilot whether or not the engine is delivering its proper power output. Some tachometers are worked through a flexible drive, like the speedometer on your auto, but the newer types are either magnetic or electric.

Fuel and oil-pressure gauges indicate to the pilot the pressures at which gasoline and lubricating oil are being pumped through the lines from the tanks. Quantity gauges are used to reveal the amount of fuel and oil in the tanks, and also to check mileage and fuel-oil consumption within a given period of time.

Several kinds of ther-(Continued on page 192)



THE SPERRY AUTOMATIC PROT, combined with the directional gyro, keeps the plane level and on course without aid from the pilot. The device prevents pilot fatigue, and also any errors in judgment resulting from faulty human sensory perceptions



A NEW TYPE OF BEDSPRING, to which a self-contained motor imparts a gyratory motion, has been developed for experimental study in producing relaxation and in the treatment of fatigue. Circular impulses are received by the springs from the weighted shaft of the motor and these pulsations are communicated to the body as a gentle massage to relax nerves and spur circulation

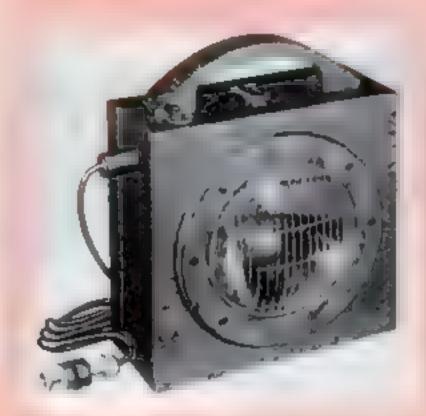


WHEN NYLON IS AVAILABLE AGAIN for everyday use, large quantities of the yern will be laomed into sheer fabrics, such as marquisette and mousseline de soie, and will make these materials hold their shape better than in the past. Yeivets waven of nylon will have added crush-resistance

HANDS OF WORKMEN are better protected from grease and other irritants if they're coated with this quick-drying lation that is easy to rinse off. The new preparation forms a film to which pily dirt wan't aling



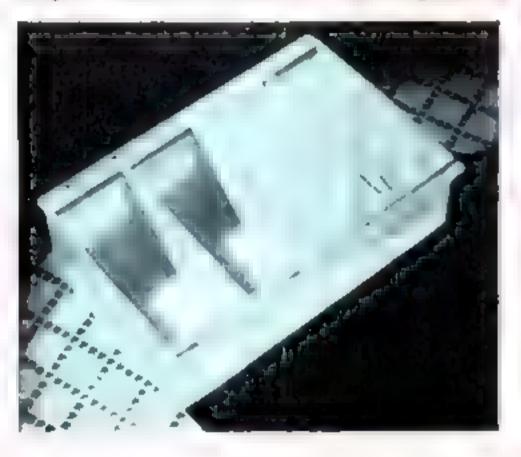
STORAGE BATTERIES in this portable lamp can be recharged from a cigar-lighter receptacle in a car, and have a usable life of 2,400 hours. The lamp measures 34" by 71" by 71", and it projects a beam 1,000' long



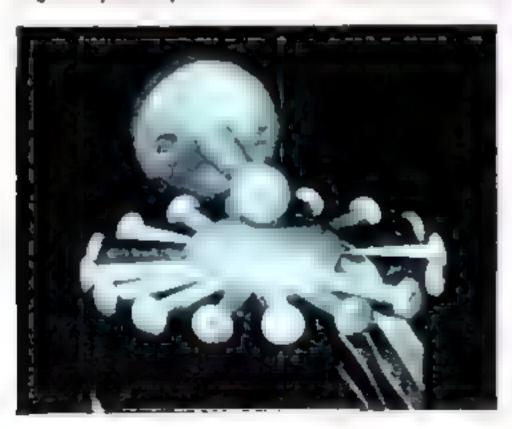
Modern Living

SHINE CAN BE REMOVED FROM GARMENTS with a new chamical solution that will not injure wool, silk, or rayon fabrics, and will even revive the nap on some goods of heavy texture. The noninflammable product will not leave a ring or fade the color of a textile while obliterating sheen from cloth spanged with it

MOLDING MARGARINE in a dish like the plastic one below will enable users of the butter substitute to serve it in the shape of a real butter bar after mixing in the appropriate color. The mold has three partitions and four individual battom sections, each of which is removable. This makes possible removal of a single bar from the form as it is needed after the margarine mixture has hardened in the refrigerator



THIS ROTATING TIE RACK, made of wood, can be fastened securely with two screws to a wall or door of a closet. Equipped with spokes for 16 ties, the pivated disk can be spun around with the touch of a finger to permit quick selection of a suitable necktie





ODORS CAN BE KILLED by means of a pawdered preparation, shown above, which removes unpleasant smells chemically rather than by masking them with other odors. When dissolved in water, it makes a solution that can be sprayed on affending objects

FOG WON'T CLING to windshields, gaggles, windows, or transparent plastics when these objects are wiped with a new compound that prevents condensation on a surface. Treated areas should be polished



Uhen Your Car Wort Start... Uhat Would You Do?

Simple Screwdriver Tests
Following a Systematic
Procedure Will Help in
Spotting the Trouble When
You Are Stuck on the Road
By RALPH ROGERS

HEN you are out on the road, with no service station or telephone near, and your car stalls, what can you do? If you have a screwdriver and a little automobile sense, you can do a lot. You can also do a lot with these two things right in your own garage if your car stalls there. And even if you discover that the trouble is something that you aren't equipped to fix yourself, you can at least give the shop mechanic the proper clue and be sure that he brings the necessary parts to get you off in a hurry.

The chances are that the trouble will be in the fuel system or the ignition, most likely in the latter. With the ignition switch turned on, you can tell immediately whether you have gas in your tank, for the gas-gauge needle should register. If you have gas, take a look at the ammeter. Its needle will show a slight discharge, which is proper; it may swing completely over to show a full discharge; or it may show no discharge at all.

Turn off the ignition switch quickly if the needle shows full discharge, for that is a sign of a ground between the switch and the coil, and it could burn off the insulation. Search out the ground and repair it. If the needle shows no discharge, it could mean a dead battery or that the breaker points in the distributor are open, or it may just be stuck.

When the ammeter needle shows a slight discharge, it indicates that current is flowing. You will already have tried your starter; that's how you know you are stalled.

But step on it again, and this time note whether the engine turns over freely, for if it does, then both the battery and starter are functioning properly. If the starter is sluggish, however, it may be because of a weak or defective battery, or the battery terminals may be loose, corroded, or dirty. It also may be caused by a mechanical failure in the starter or starter switch, or by a broken cylinder-head gasket that has allowed water to seep into one of the cylinders.

To determine what part of the starter circuit is at fault, turn on the light switch and step on the starter again. If lights go out or become dim, the trouble is probably in the battery or its connections. Clean and tighten the battery connections

Clean and tighten the battery connections and the cable terminals, and replace any doubtful-looking cable if you have a spare one. The battery itself may be tested with either a hydrometer or a voltmeter if one of these is available. A hydrometer reading should indicate better than 1.250 specific gravity for a battery that is in good condition, while a voltmeter reading taken across the positive and negative posts should indicate about six volts, or close to whatever the voltage of your system happens to be.

If the lights remain bright when the starter button is pressed, the trouble may be between the battery and the starter, or the starter switch may be at fault. Try the connections in this part of the circuit first, If they are clean and tight, look for the disorder in the starter or the starter switch.

Should the ammeter needle refuse to budge when you step on the starter, there is no current flowing. This may mean that the breaker points in the distributor have been burned or that there is a loose or broken low-voltage wire or connection between the distributor and the ammeter. With a screwdriver, ground the low-tension wire at the distributor terminal. If you don't get a spark with this test, the current is cut off somewhere in the connections leading back to the ammeter. Working backward, ground each of these connections with the screwdriver until you come to one where

you do get a spark. The trouble will lie at this connection or between it and the distributor.

If you get the spark at the distributor terminal, it is an indication that current is flowing at least that far, and it is usually a safe bet that the fault will be found in the distributor—most likely the breaker points will be burned or dirty. Take off the distributor cap and check the condenser terminal and the condenser hold-down screw for tightness; then examine the condenser lead wire for a break. Should these things be found in good condition, open and close the breaker points and watch for a spark. If you fail to get one, the points must be cleaned and adjusted.

This cleaning can be done effectively enough in an emergency with the abrasive strip from a paper of matches, with a knife blade, with the sharp edge of the screw-driver, or with anything else convenient that you can use to scrape the scale from the contact faces. If you have no gauge for setting the gap, a quick adjustment can be made by using a piece of newspaper folded into four layers. This thickness will be about .020", which is the approximate gap setting for most distributors.

Suppose, when you stepped on the starter, the ammeter showed a discharge of from 3 to 5 amp. and the needle fluctuated rhythmically. This 3 to 5 amp. is the normal current the ignition coil draws, and fluctuation of the ammeter needle, which is caused by the opening and closing of the points, indicates that current is getting to the points. Should the ammeter register between 3 and 5 amp. but remain motionless

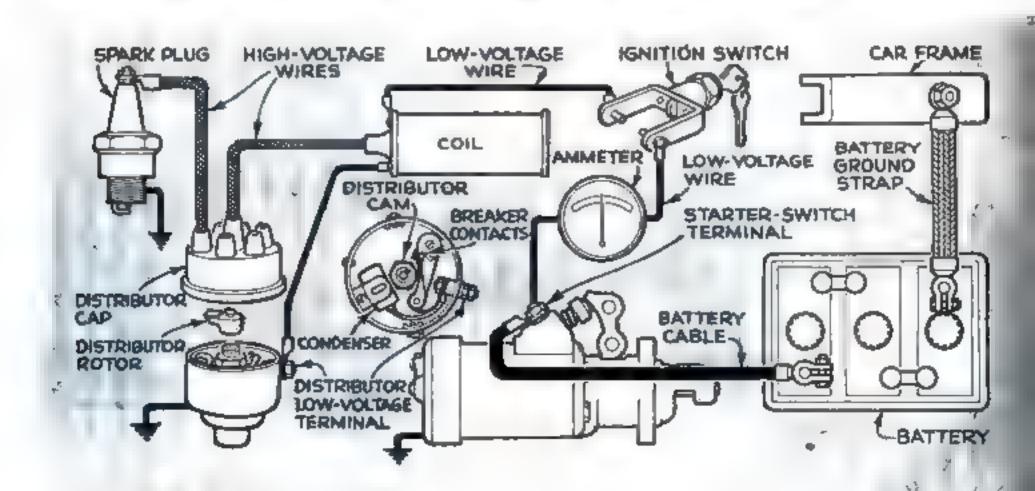
when the engine is turning, start looking for a short somewhere in the distributor or the low-voltage lead connected to the coil.

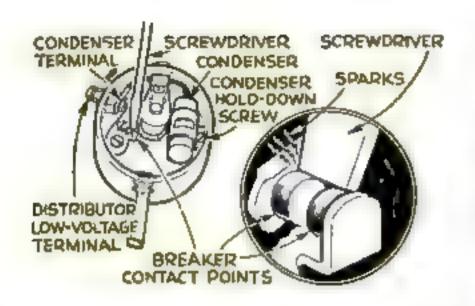
There is a good chance that the short will be in the condenser, so check this first by inserting a piece of paper between the breaker points to keep the current from flowing to the ground. The ammeter needle should return to zero if the condenser is good. If the needle still registers, take out the condenser hold-down screw and move the condenser away from the distributor. Should the needle now return to zero, the condenser is shorted and the current is leaking through its insulation. Unless he has been forehanded enough to take along a new condenser, there is not much that the average motorist can do about this except to thumb a ride or start walking to the nearest service station or telephone.

Another way of checking for a defective condenser is to examine the breaker points. If the contacts show a distinct blue tinge with a hard scale on the surfaces, the condenser is leaking. To check further, crank the engine until the breaker points open; then turn on the ignition switch and bridge the points with a clean screwdriver blade. If there are no sparks, the condenser is defective. For further proof, disconnect the condenser wire and again bridge the points with the screwdriver. If the screwdriver does draw sparks this time, it is a sign that the defect is in the condenser.

Should the ammeter-starter test prove O.K., that is, the needle show a discharge of from 3 to 5 amp. and fluctuate when you press on the starter button, there still may be trouble in the ignition system, or there

WHERE TO TRACE FOR A BREAK IN AN AUTO IGNITION SYSTEM





Sporking should occur when the breaker points are bridged with a screwdriver. If the condenser is leaking, you will not be able to get a spark

may be a stoppage in the fuel system. Look into the high-voltage circuit first. Remove the wire from one of the spark plugs and have someone press on the starter button for you; then, while the engine is cranking, hold the terminal of the wire %" to %" from the engine or spark-plug base. If you get a fat spark that readily jumps the gap, the trouble is in the spark plugs or in the fuel system.

Before going any further, wipe the outside of the plugs to remove any dirt or dampness that would short-circuit the high-tension current, and then try to start the engine again. Should it still fail to start, remove one of the plugs. If the plug is wet around the base, it is an indication that the fuel system is all right and, naturally, that the spark plugs are at fault. Remove all of the plugs, clean them, and set the gaps. An emergency adjustment for this last can be made by folding a piece of newspaper into

five layers for use as a gauge. Always bend the side electrode, never the center one, when changing the gap, as there is danger of breaking the insulation.

If the spark plug you first examine is dry at the base, check the fuel system. A quick test can be made by simply removing the air cleaner and looking down into the carburetor throat while the throatle is jiggled back and forth. If there is fuel in the carburetor, the accelerating pump will push gas through the pump jet, and the choke valve should then be checked. This valve should be closed when the engine is cold. If fuel is reaching the carburetor and the choke

won't close, the engine can be started by covering the carburetor throat with your hand to prevent the entering of air while the engine is cranking. Don't choke this way after the motor catches; the vacuum created can injure your hand severely. Try priming the carburetor if you have one you can't see into. If the motor then catches but stalls again, fuel isn't getting into the carburetor.

** > * To **INDO (作) (diponje)

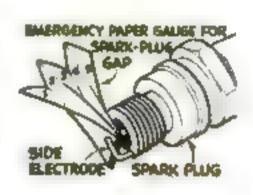
Operation of the fuel pump is checked by disconnecting one end of the fuel line from the pump to the carburetor and cranking the engine. Fuel will spurt out of the line if the pump is working. If it doesn't, check for clogging in the line from the tank to the pump before putting the blame on the

pump. Disconnect the line at the inlet side of the pump, remove the tank cap, and blow through the line. There should be a gurgling sound from the gas tank if the line is open. Be sure in addition that the air valve, or the tank-cap pinhole, which permits air to enter the tank as fuel is drawn out, is functioning properly.

If the pump seems at fault, remove the sediment bowl and clean the screen; then replace them, being sure that you have an airtight fit. Use a new bowl gasket, if possible, because it is sometimes difficult to get an airtight fit with an old one. If you have no new gasket at hand and the bowl won't fill up after being replaced, you can swell the old cork gasket by heating it with a match, but take care that you do not set it afire. Should the pump still refuse to function, it will have to be removed and repaired—unless you have been forehanded enough to carry a spare pump or diaphragm.

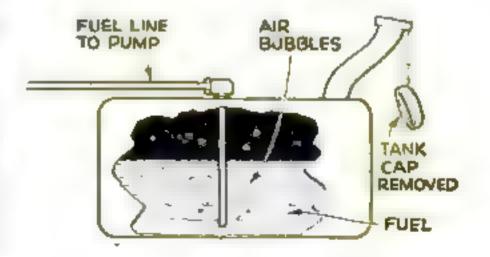


Folded newspaper forms a .020" thickness gauge that is near enough for setting a distributor gap



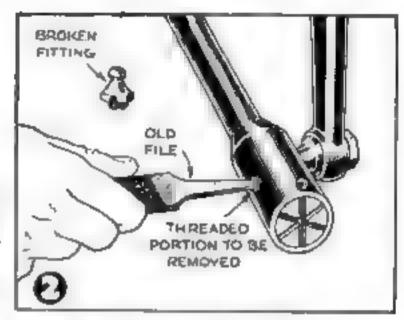
Newspaper is also used for emergency setting of spark-plug gaps. Bend only the side electrode in making the adjustment

Stoppage in a gas line is found by disconnecting the line at the pump and then blowing through it. Gurgling will be heard at the tank if it is clear



USEFUL AUTO HINTS



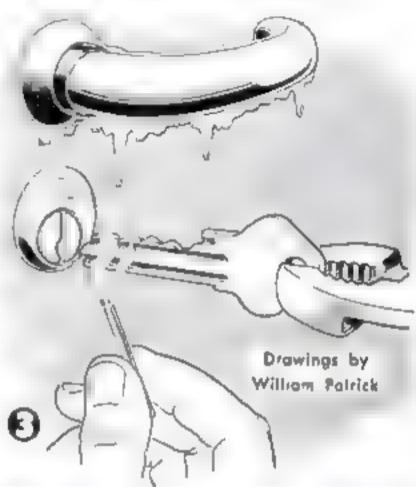


I ICE ON CAR WINDOWS can be removed handily with the aid of a homemade scraper that can be put together in a few minutes. For the blade of the tool a stiff material—such as a fiber or a plastic that can be beveled to an edge—should be used. Avoid metals hard enough to be likely to scratch glass.—D. V. D.

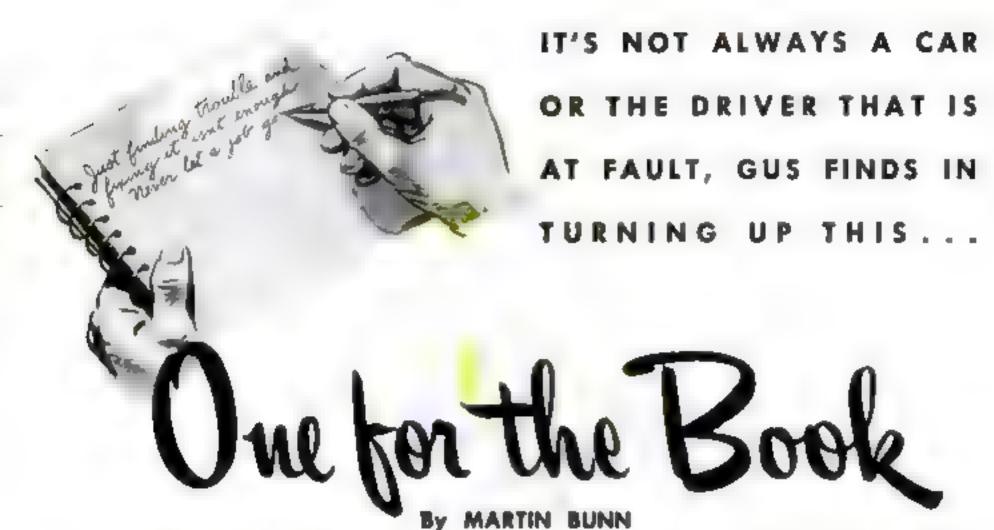
2 BROKEN GREASE FITTINGS often present a difficult repair problem because of the shank left embedded in the threaded hole. Such a shank can usually be removed with the tang of a small file. If not stuck too tightly, the shank can be retrieved by tapping the tang lightly into the hole and twisting so as to unscrew the broken part. With the aid of a wrench, apply just enough torsion to turn out the shank without breaking the file.—L. R. F.

A FROZEN DOOR LOCK will yield quickly to thawing if the key is heated over a match flame and inserted in the keyhole while it is still hot. If the lock is frozen solidly, it may be necessary to repeat the operation a few times. Hold the key with pliers, for brass conducts heat very rapidly, and a key hot enough to melt the ice may be too hot for the hand.—G. T.

4 THAT EXTRA CUSHION, so comfortable to some drivers on long trips, will not get kicked around on the car floor if it is neatly and conveniently suspended from the seat back. Hang the cushion on a pair of straps, so that it can be flipped over the seat and into place behind the driver's back whenever it is wanted.—H. S.







STAN HICKS, the Model Garage's current Sprease monkey, is Gus Wilson's one brag. Stan is not quite eighteen, and Gus gave him a job last June, the day after he graduated from high school. He has a born knack of making machines run right. Gus appreciates that natural aptitude, and even more, the fact that Stan is always trying to learn.

Shortly after taking Stan on, Gus discovered that the kid was keeping a note-book on the job, writing down everything he told him about car work and looking up things in it instead of asking the same questions over and over again. It made a big hit with Gus. "That boy's going to get somewhere before he's through," Gus keeps saying.

So it was with no misgivings that Gus agreed to go over to the Edensville war plant on a truck job that he figured would keep him all day. He left Stan in charge of the shop at the Model Garage with only one admonition: "Take care of the jobs you're sure you can handle; leave the others for me."

Stan felt pretty big. His first job was cleaning fouled spark plugs, and he took it in stride. The next one, installing a fan beit, was another pushover.

Some time later a horn honked outside, and Stan hurried to answer the summons. An ancient green sedan had its battered radiator poked almost against the shop door. Behind its wheel lounged a husky youngster in work pants and a plaid shirt, and beside him sat a pretty girl wearing slacks.

Stan ignored the driver and addressed the girl: "What's cookin', good lookin'?"

She giggled instead of giving an answer. "Hey, jerk," the youth with her said, "I want to talk to the man in charge, not to the grease monkey!"

Stan's face got red. "That's me, Mac," he said. "I'm the man in charge. What's the trouble with this crate of yours—besides old age?"

"Stop trying to be funny, you two," the girl said. "Cail your boss, will you?" she told Stan. "There's something the matter with this jalopy, and my brother—"

"Oh," Stan interrupted, "this guy's your brother, is he?"

She giggled again. "You didn't think I'd picked him for my share-your-car club, did you?" she asked.

The youth behind the wheel grinned widely. "Nuts to all this shootin' the breeze," he said. "I got to get this car fixed quick. She went sour on us going to work last night, and she was worse coming home this morning, and we've got to drive her back to make the graveyard shift tonight. Six and I both work in the war plant over in Edensville, and we sin't either of us missed an hour's work since we've been there. Call your boss out here, will you, bud?"

"The boss is away for the day, and I'm running the shop," Stan told him. "Maybe I can fix you up. If I can't, I'll tell you so, and you can take it somewhere else. That's fair enough."

The boy thought it over for several seconds. Then his sister nudged him. "That's all right, Joe," she advised.

"Well then, feller," Joe told Stan, "going to the plant last night from home—we live out in Pleasanton—every time we'd get up to thirty the motor would lose its power and start to miss. I thought it was a spark plug but I found out it wasn't any one cylinder that was missing—first one would cut out and then another one. When I kept down to twenty-five, she ran all right without any missing.

"Coming back this morning she acted the same way, only worse. About halfway over here the heat began to climb, and by the time we got to a service station the radiator was darned near dry. While I was filling her up, the feller there told me you had a whiz

of a trouble shooter here at the Model Garage. You sin't that guy, are you?"

"Nope," Stan said.
"That's the boas, Gus
Wilson. He's tops. But
he's taught me all his
stuff, so I guess I ought
to be able to fix you
up." He pushed back
the sliding door, "Drive
her in," he directed
professionally.

Joe drove into the shop, and he and his sister got out of the car. "Never mind about me," she said, perching on Gus's workbench and fishing a mirror, a lipstick, and a pack of cigarettes out of a handbag. "Get the car fixed. I want to get home and get my beauty steep."

Stan started checking. There didn't seem
to be anything wrong
with the ignition system. Both the fuel line
and carburetor were
all right. He looked
disappointed. The girl
giggled.

"Can't you find anything?" Joe demanded. "You can't always tell with a car standing in the shop," Stan said. "I'll give it a road test."

Joe snorted. "Go ahead," he said. "Enjoy yourself. I'm going over to the diner and have breakfast. Coming, Bee?"

"No," Bee said. "I'd rather eat when we get home."

Joe went out. Stan got into the car and looked at Bee. "Want to come?" he invited. "Why not?" she said, and got in.

Stan backed the car out and drove up the highway, trying to keep his mind on the performance of the engine. It ran smoothly at twenty-five, but missed at thirty. After they had gone a mile, Bee spoke for the first time. "Take a look at the thermometer," she said. "It's over in the red."

"Yeah—I was watching it," Stan lied.
"The radiator needs water. We'll stop at



that service station up ahead and get it."

Stan filled the radiator, and they drove on. He speeded up to thirty, and held that speed for a mile with the engine missing badly. Then he stopped, got out, and raised the hood. He saw that the cylinder heads were wet. But when he checked the radiator hose connection, he shook his head—the clamps were tight. Then he noticed something else—that water was oozing out of the hose from a dozen small holes.

He got back into the car jauntily.

"Well?" Bee asked.

"I've got it licked," Stan told her confidently. "Your radiator hose is rotten, and water leaks out. That doesn't make any difference—except that the radiator runs dry and the engine overheats—when you're driving real slow. But when you get up to thirty, the air from the fan gets strong enough to spray water over the engine, and that makes the plugs short. Get it?"

"No," Bee said. "But I think you're wonderful to have found the trouble after Joe

couldn't."

"Oh, that's nothing-all in the day's work," Stan told her airily. "It all depends on the sort of training a man's had."

Gus and Stan were busy in the shop a few mornings later when Gus's partner, Joe Clark, who takes care of the office, came in. "There's a fellow named Chisholm on the phone," he announced. "He says his car stalled about halfway between Pleasanton and Edensville last night. He wants us to send the wrecker. He's coming on the bus. He says Stan knows him."

"Sure, I know him," Stan confirmed.
"He's the fellow whose radiator hose I replaced—the one I told you about, Mr. Wil-

son."

When Stan maneuvered the green sedan into the Model Garage shop an hour later, he found Joe and Bee Chisholm there.

Gus raised the hood, looked at the engine, and nodded. "The cylinder head is cracked. Didn't you know your radiator was dry?"

"Why should I?" Joe Chisholm demanded, "Stan put in a new hose,"

GUS SAYS:

With new tires scarce and growing scarcer, a car owner nowadays must do more than drive carefully, watch air pressure, and switch regularly from wheel to wheel. If he wants to keep rolling, he'd better get tires recapped before they're worn down to the fabric—it may be too late then!

"Well," Gus said, "the cylinder head will have to be replaced. It'll be an expensive job, and it will take several days to get a new head."

Joe looked at his sister. "What are we going to do for a car?" he said.

"We've got to get over to the plant every night," she added. "We've got a record."

"You can use my car," Stan offered.
"It's a ramblin' wreck, but it'll get you there and back if you treat it nice."

"Say-thanks," Joe said.

Gus had his head under the raised hood. He straightened up. "Where do you keep this car of yours?" he asked.

"In our stable—Pop's got a farm," Joe told him.

"Any mice in there?" Gus inquired.

"Sure---it's lousy with 'em," Joe admitted.

"Just curiosity," Gus said. "By the way -- there won't be any charge for the cylinder head."

"What?" yelped Joe. "Say-thanks"

"Scram, you kids," Gus said. "I'm busy."
Stan walked to the shop door with the
two Chisholms, and came back grinning.
"Say, boss," he asked, "why aren't you go-

ing to charge for this job?"

"Because I forgot to tell you something important," Gus said. "It's one for the book—so get that notebook of yours and write it down. Ready? Here it is: Just finding trouble and fixing it isn't enough. Never let a job go out of the shop without finding out what caused the trouble—and without trying to do something to keep it from causing it again. . . Got that down?"

"Yes," Stan said. "But what's it all about?"

"Take a look at that radiator hose," Gus directed. "Full of little holes again, isn't it? Mice chewed those holes, same as they did in the old one—they like rubber hose for some reason. All the water had leaked out of the cooling system before your friend Joe drove his car out of the stable. That's why the engine heated up so badly that the head cracked. You should have found out that mice chewed holes in the old hose, and put wire screens around the new one to keep them from chewing it."

Stan looked so downhearted that Gus felt sorry for him. "It was my fault for not telling you," he said. "Forget it—or, better, remember it for next time. . . Let's see what you've put down in that book of

yours."

Stan handed him the notebook. Gus looked at it, and his eyebrows went up. "Pleasanton 243-J." he read. "What's that code?"

Stan got red. "Y-you're on the w-wrong p-page," he stuttered. "T-turn over!"

AUTO (deas

MADE OF ELASTIC PLASTIC, the inner tube shown at the right is said to be long-wearing and to retain air better than natural or synthetic rubber. Resistant to abrasion and impervious to sunlight, acids, and alkalies, tubes made of this vinyl-type plastic are so airtight that they have traveled more than 6,000 miles without needing additional inflation. The makers also say that the substance is 100-percent reclaimable, and that it can be fabricated into tubes more easily than rubber.



CLOSE TO 60 M.P.H. can be reached by the midget homemade motorcycle shown above, while the bike-wheeled roadster at the right, also improvised by its owner, utilizes a 1½-hp. lawn-mower motor to make 35 m.p.h. and cover 60 miles on a gallon of gasoline. The speedster at the lower right is a factory job, but is not yet in production.

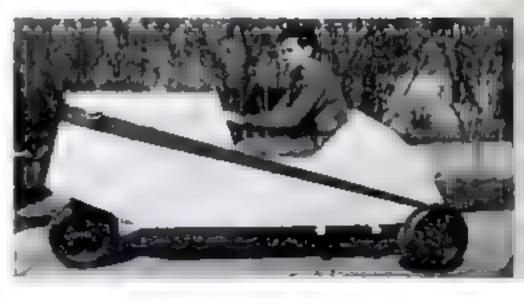
Put together out of a medicy of parts cast off from various ancient motorcycles and autos, the midget motorcycle includes a one-cylinder motor of 1923 vintage. The frame was cut down from a frame that was standard in 1925. For a transmission, the maker, William M. Scott, of Upper Darby, Pa., delved as far back as 1916. Old Model T Ford brake drums were welded into airplane rims, and the handle bars, fenders, and lamps came from a scrap pile.

No leas a miscellary was collected for the little roadster. Fred H. Perry, of Lansing, Mich., used four bicycle wheels and the body of an old buggy complete with springs, while junk yards yielded most of the remainder. A planetary transmission gives the 800-lb. vehicle two speeds ahead.

The tiny factory-made speedster has only three wheels. It is powered by an electric motor that will produce a top speed of 25 mp.h. and run 30 to 40 miles on a single charge of the batteries, which can be renewed by attaching an automatic device to any 115-volt A.C. service line.







MARCH, 1944

Home and Workshop



Puffing Pioneer of the Auto Age ... Faithfully Detailed Even to Brass Head Lamps, This Model Is Reminiscent of Days When Our Century Was Young

GASCLINE BUGGY--1903 STYLE A COLORFUL MODEL OF AN EARLY OLDSMOBILE THAT SCORCHED THE ROADS FORTY YEARS AGO

By J. N. HALSTED

RWARDING to the careful modeler but not difficult to construct, this 1903 Oldsmobile is a detailed reproduction of one of the first cars to catch popular fancy. A comparatively large number were sold, and to many a citizen the sight of one chugging merrity along was his first glimpse of the automobile age. A full-color photograph of this model may be seen on page 88.

Cut out the bottom and sides from thin sheet metal or tin plate. Solder the sides to the bottom, drill holes for the fender-support rod, and solder this in place so that it extends %" from each side. Next, solder on the engine housing, the back of which is left open, with a cross rod soldered inside in

order to support the drive chain.

Attach the side springs, built up of 4" wide brass strips 1/32" thick, with escutcheon pins soldered inside the body. Drill a hole in the right side for the gearshift lever and solder the notched gearshift guide in place. Note that the round lever is inserted first through the hole in the flat lever and then through the body, where a simple clasp soldered to the floor holds it in place.

The metal apron which constitutes the seat support is now soldered on, together with the seat base and sides. Use a 3/32" brass rod to make the steering lever, with an arm ½" long soldered to it at the bottom. Slip a piece of brass tubing or a wire ring, C in one drawing, over the rod, but do not secure it until later. Drill a hole in the floor for the steering lever and solder a ½" length of tubing at B, the underside of the floor at the hole.

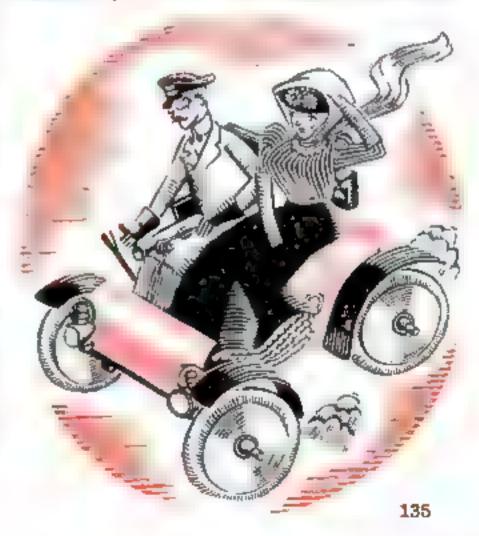
Make the front spring of %" brass strips, shaping and soldering together the main leaf before adding the others. Escutcheon pins soldered in the ends will serve as shackle bolts. Place a small filler block of solder on top of the spring after it has been attached to the dash with an escutcheon pin.

The axle housings, rods about 3/16" in diameter, are fitted as shown with short lengths of brass tubing soldered in place. In forming the steering-knuckle assembly, use either a rod or very small tubing for the upright post to which the wheel spindle is

soldered; if a rod is used, it will be necessary to drill it for the kingpin. Fasten a tie rod between the steering-knuckle assemblies; and since the lever at the end of the steering rod swings in an arc, join it with a 1" link to the tie rod.

Attach the side springs to the front axle housing with escutcheon pins, riveting the ends under the axle. Adjust the steering rod to the proper height, slide down the collar A until it rests on the floor, and solder it. Then solder C so that it also bears against B. Although held snugly, the steering rod should work its linkage and guide the wheels.

Cut out the drive gear, slide it on the rear axis housing, and solder two pieces of tubing against it. The axis housing itself should be somewhat shorter than the distance between the wheels, and pieces of tubing should be soldered to each end to bring the axis housing to the proper length. The wheels turn on spindles which are set in solder inside these tubing collars. These spindles, the actual axis on which the wheels spin, should extend \%" beyond the wheels spin, should extend \%" beyond the wheel hubs. After the wheels are mounted, 7/32" brass tubing is slipped over each spindle up to the hub and filled with solder;



then the tubing, solder, and spindle are sawed off '4" from the hub and the end is rounded.

Rivet the side springs to the rear axle housing also with escutcheon pins and mount the drive chain, which may be from a piece of dime-store jewelry. The lamps are turned from brass, or, if a metal-working lathe is unavailable, they can be turned from wood and covered with gold leaf or painted a golden bronze. Glue in disks cut from unbreakable watch crystals to give the effect of lenses.

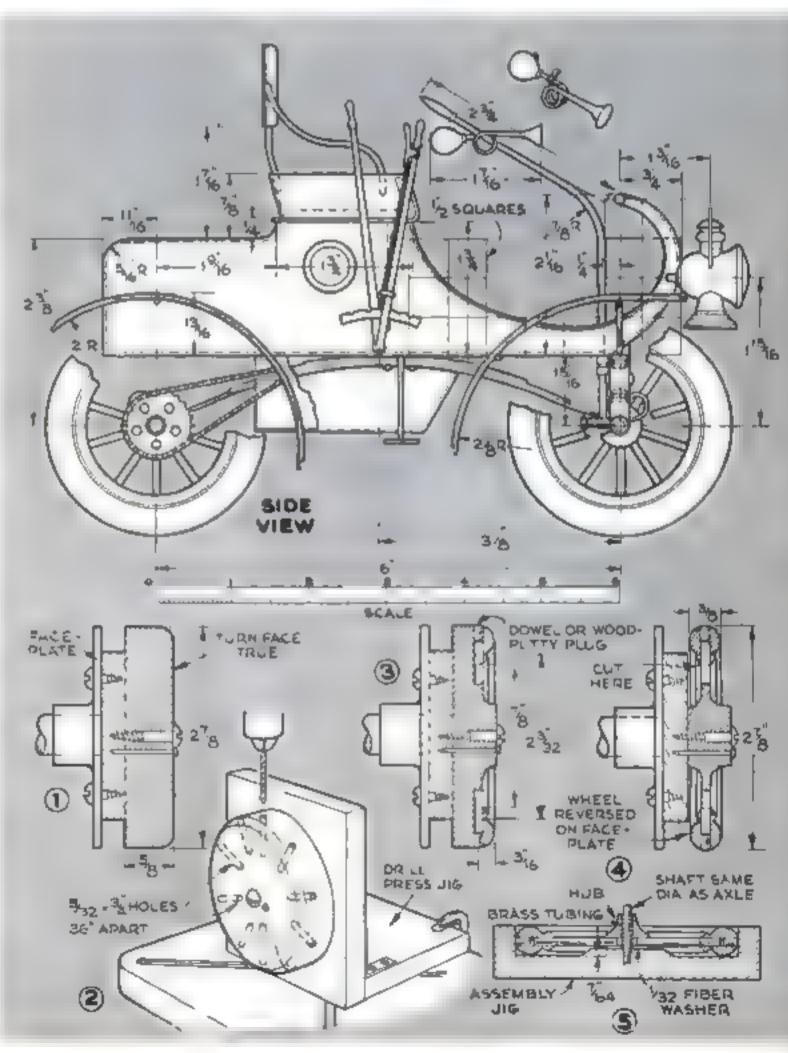
To make the wheels, turn a piece of %" stock to make a disk 2 %" in diameter, and round the outer edge of this disk as in Fig. 1.

Then mount the disk in a drill-press jig as shown in Fig. 2, and drill ten 5/32" holes around the periphery of the wheel, spaced 36 deg. apart. These holes, about %" deep, should be located on a line 3/16" from the outer side of the wheel. Plug the holes to a depth of %" or less with wood putty or lengths of dowel.

Mount the disk as before on the faceplate, sand the plugs smooth, and turn the outer portion of the tire and felice (Fig. 3). Reverse the work on the faceplate, turn the remainder of the tire and felice (Fig. 4), and cut off the rim at the inner felice line. Next, make an assembly jig—a block receased %" by 2%", with a 7/64" boss left in



Careful attention to small details in the construction of this project will justify a modeler's efforts. Paint the cushions, fenders, and running gear black, and use rich red on the body, felioes, and spokes. Apply clear lacquer to all brass parts



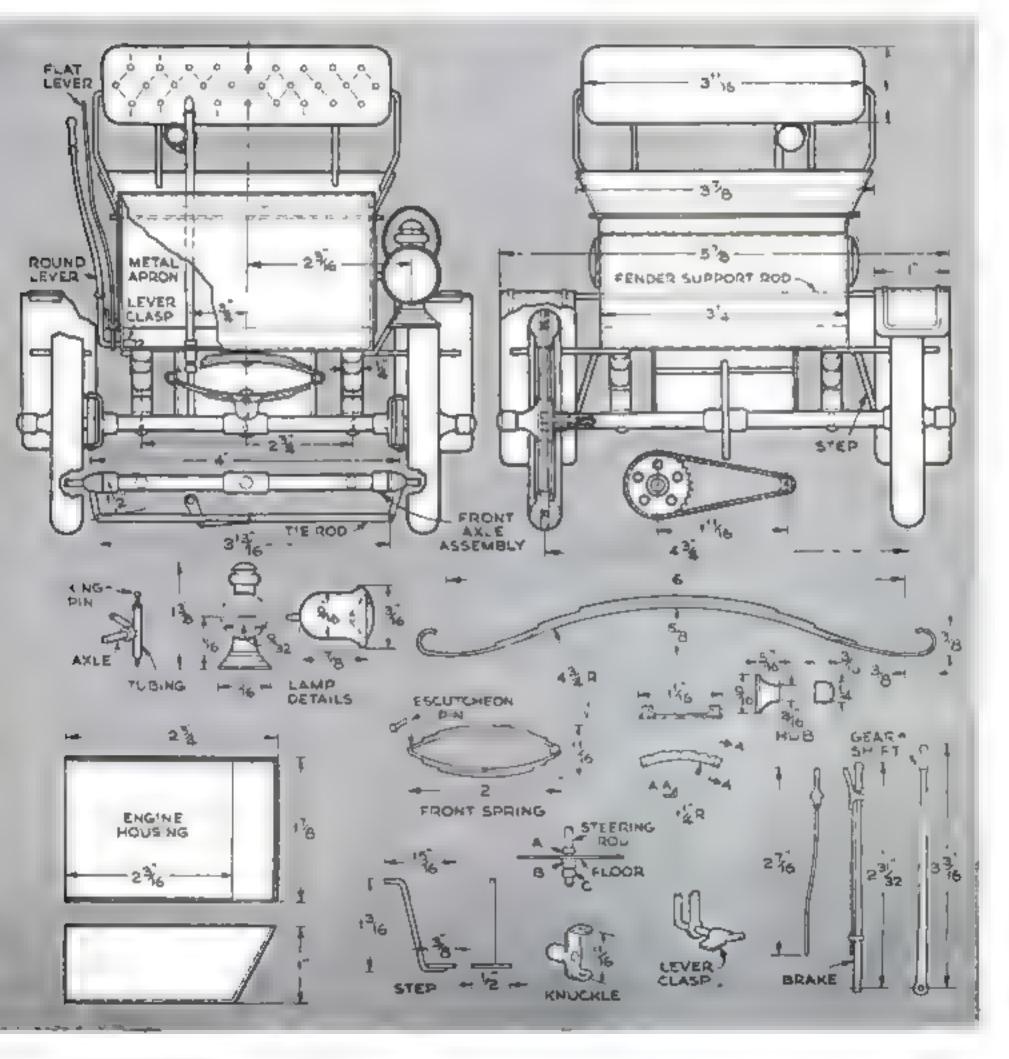
the middle. Insert a shaft the same diameter as the axle in the center hole, and on it drop a 1/32" by 9/16" fiber washer. Then slip on a close-fitting piece of tubing to serve as the wheel bearing.

Glue the 3/32" spokes in the holes in the rim, inserting them from the inside. These spokes, about 1" long, need not meet precisely at the center, provided they are adequately covered by the hub turning. The rim and spokes are dropped into the jig, a daub of glue is added to the center, and the hub turning is pressed in place (Fig. 5).

Turn the bulb and bell for the horn from brass, and solder them to a colled wire. The bell can also be filed from a length of 3/16"

brass rod, with the inside contour formed by drilling a hole and then countersinking or scraping it. The bulb can be a ball of solder filed to shape.

The seat back, arm rests, and handles are next soldered in place. Carve the seat cushions from wood or linoleum, using the heads of pins as buttons, and glue them to the seat and back. Cut the fenders from sheet metal—preferably somewhat heavier than tin-can stock—and solder on thin wire all around the edges to resemble a stamped beading. The steering-rod handle is built up with solder and filed to shape, and the rod bent last of all. Small dime-store ornaments may be mounted on the sides of the body.



How Small Is

ONE TEN-THOUSANDTH OF AN INCH

UST what is this .0001" we hear so much about nowadays?

If you had been an Englishman living in 1324, one ten-thousandth part of an inch would have struck you as highly theoretical, an abstraction suited only to cloistered visionaries, if not a downright absurdity. For the standard of accuracy had just been set by statute of Edward II as an inch, defined as the diameter of three barleycorns, round and dry, taken from the center of a good spike.

Far from an abstraction, .0001" is today crucial to modern warfare. Without meticulous specifications as fine or finer than this, our machine guns, rifles, artillery, range-finding instruments, and plane and tank engines, for example, would not be the precision mechanisms they now are.

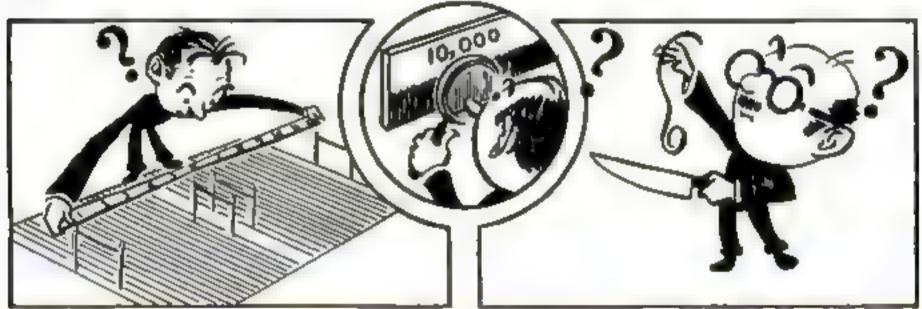
It is difficult, perhaps impossible, for the human mind actually to grasp the concept of one ten-thousandth part of anything. If you were to set out to toolk from Chicago to New York City, you would cover .0001 of the entire distance in less than two minutes—and, quite rightly, feel you hadn't gotten anywhere. A .22-cal, rifle bullet manages to move less than 1½" in .0001 second. The tip of the hour hand on your watch takes hardly more than one second to move .0001".

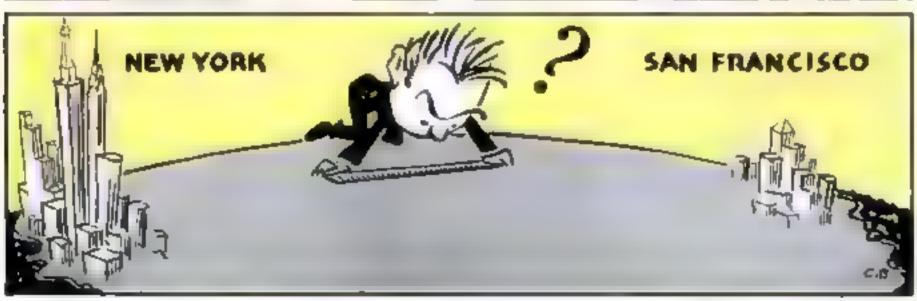
An accurate model of the entire earth, scaled .0001" to the mile, would be less than

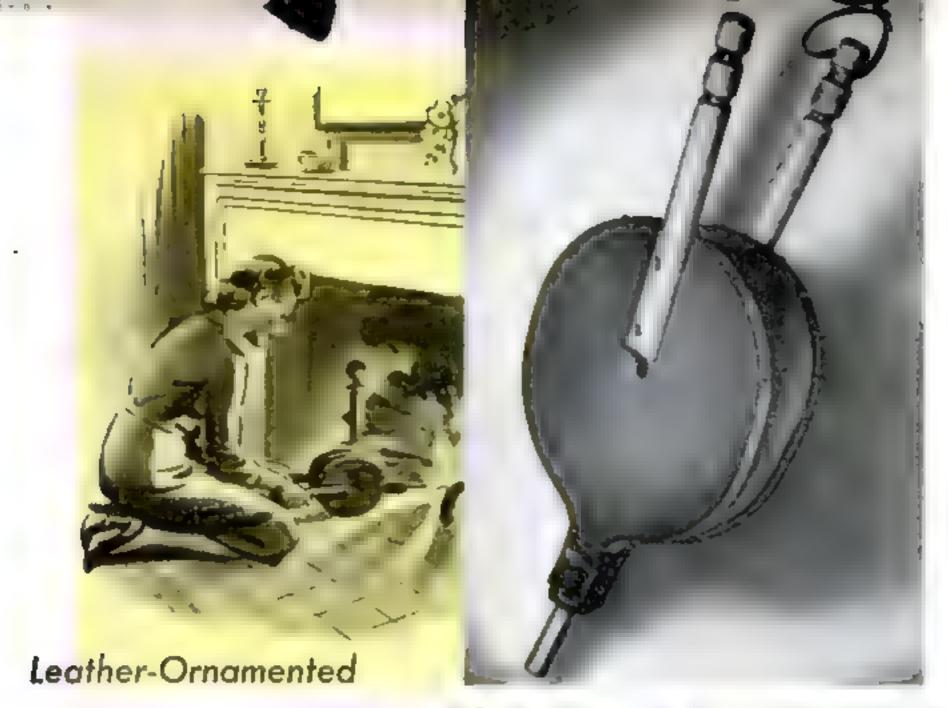
half the diameter of a golf ball. Again, imagine a cube that is 52 feet on a side. A slice of it that is .0001 of its total thickness would be only 1/16". You would have to split an average human hair into 30 equal slices to divide it into alivers .0001" thick, which would really be splitting hairs. A period on this page seems pretty tiny, but it would have to be reduced to 1/16 of its present height in order to become .0001 of the height of the page. And even then it would still be nearly 10 times as tall as a period .0001" high.

If you were to measure the distance between New York and San Francisco with a yardstick, making an error of .0001 of the whole, you would be less than a third of a mile off (and probably footsors as Well). Imagine a foot rule that has been engraved so finely as to show .0001" divisions. You would have to stretch this rule until it was as long as two football fields for the distance between two marks to equal 1/16."

With a steel rule having .01" divisions, and aided by a magnifying glass, good light, and good eyesight, you would be lucky to make correct measurements even to within a few thousandths of an inch. In industry, however, measurements accurate to .0001" are quite common. They are made with such devices as vernier micrometers, gauge blocks, and amplifying comparators.







FIREPLACE BELLOWS

A Decorative Hearth Accessory Designed by Ernest R. Dewalt

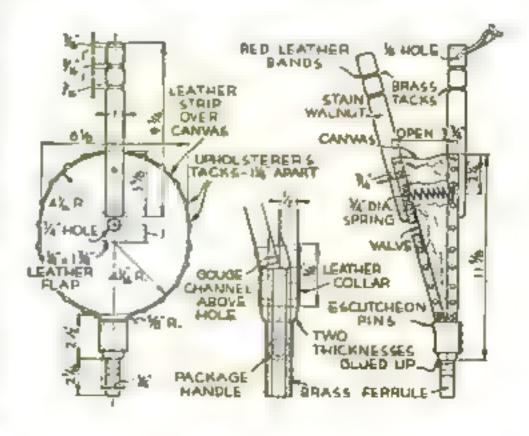
able for making these bellows, which will prove useful for dusting out nooks and crannies as well as for a hearth. Begin by cutting both the front and back walls together, and then cut off the neck of one wall at the point where it is to be hinged.

Glue and brad the small severed piece to the other neck, and drill the two with a hole to accommodate a wooden nozzle.

For the nozzle itself, use one of the tubular wooden grips of a package handle, and glue it in the hole in the neck. Provide for the passage of air by gouging out the inside of both walls just above the neck. Then in one wall drill a hole for an intake valve, and nail a leather flap under it. An inner expansion spring is optional, but will make the bellows easier to handle. If used, bore the walls with blind holes to receive the ends of the spring.

Heavy canvas will do, but leather is better for the flexible sides of the project. Fit and mark the material carefully so that it tapers toward both ends from a 3% width at the center; then cut it. Starting at the top center of a wall, glue and tack the material down

to the neck, completing both walls on one side of the beliows before fastening it on the other side. Trim the edges of the material and cover them with a leather gimp secured with roundhead brass tacks. Bind the wooden neck with heavy leather held by brass brads, and sheathe the nozzle in a brass ferrule. Finally, turn and attach the handles. Working time, 44 hours,

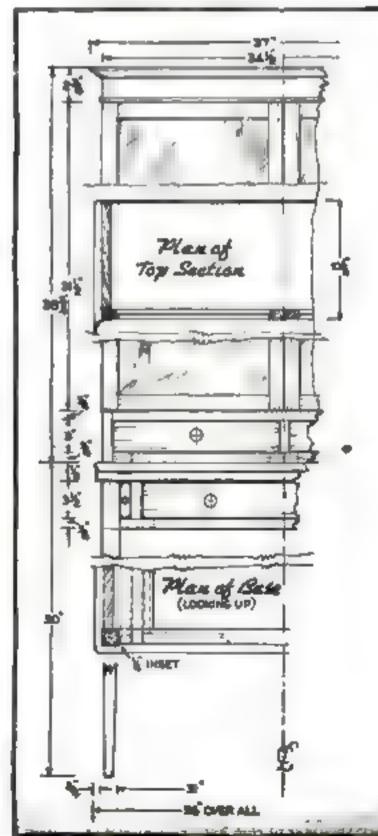


MARCH, 1944 139



A CENTURY and more ago the Shakers, a religious sect in New York State, made furniture of simple, fine lines and of structural efficiency and dignified beauty. Designed along the bonest, graciously proportioned lines of Shaker furniture, this pine bookcase-desk (or secretary, if you prefer) can, for all its importance and utility, be made of readily available materials.

Clear or knotty pine is the traditional wood, but cherry, maple, birch, walnut, butternut, or gum is also excellent. Dimensions may be altered if your boards do not measure 11%" wide and you want to avoid gluing up stock. Drawer bottoms and the back may be either plywood or wallboard. The tapered legs should be maple, birch, or equally strong close-grained wood. They are tapered from the point where they meet with the aprons. and thin off equally from 1%" square at the apron line to %" square at the foot. The legs are doweled into these aprons or cross



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members, which are set back ¼" from the faces of the legs.

To keep from exposing end grain, make each leaf support and adjacent partition of two pieces glued up as shown. The partitions should allow for a setscrew or dowel to limit movement of the lid support. Ordinary wide butt hinges may be used for the leaf if desk butts are not available. They are set flush with the writing surface, and the leaf and fixed top are also perfectly flush.

The back of the top section is rabbeted into the sides and supported at the top by a cleat. Door and drawer knobs, to be authentic, should be turned to the profile shown, but stock knobs or simple metal pulls will serve.

Finish is quite important. The more sanding done and the more

the edges are softened, the better the result will be. This is because so simple and unaffected a piece must show neatness and craftsmanship to avoid a crude effect.

Sand and rub a shellac base until you have achieved a silky surface, and then wax.

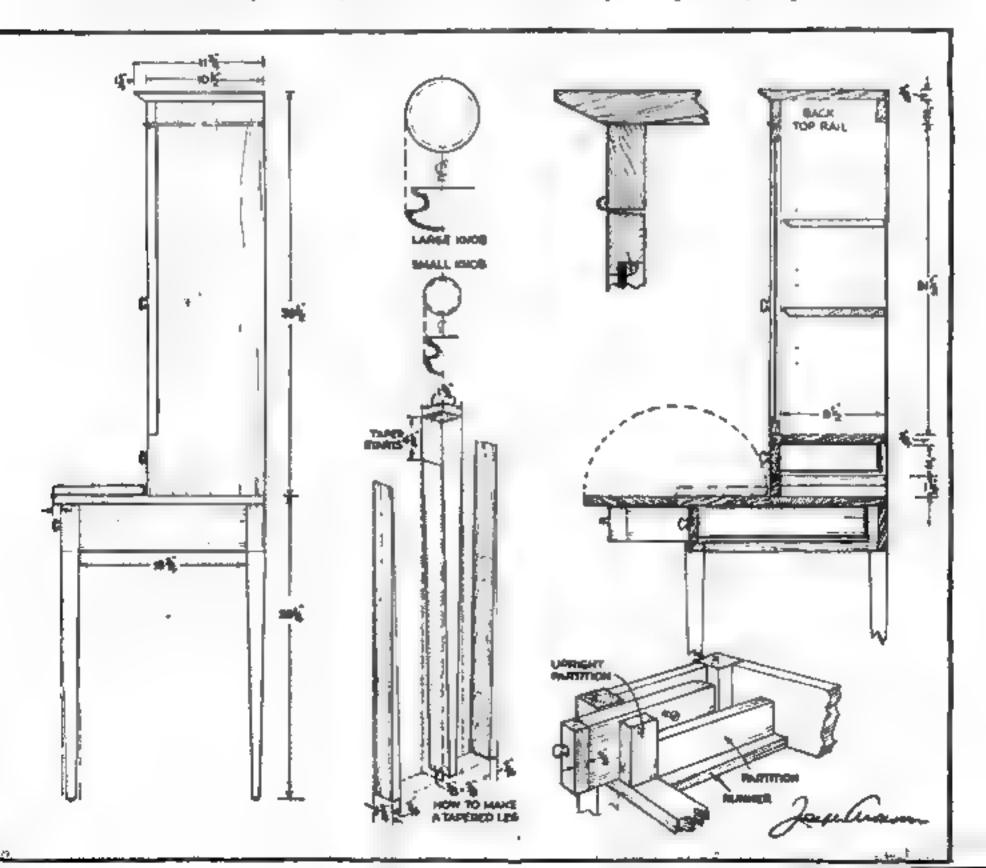
LIST OF MATERIALS

DESK				BOOKCASE			
No Description	¥.	w	L	No. Pc. Description	t	w	Ł.
I Top	100	20	36	II Top	36	1136	37
2 Side aprons	桂	4%	15%	2 Sides	- 34	10%	30%
1 Book opron	8	4.5	31	1 Bock (plywood)	14	33%	38%
L Frantina	16	La	31	I Top front rod	4	2	24%
4 Legs	13,	+30	20 2	For Joed 90*	16	- 2	33
2 Bunners	- 84	315	16 .	Legistrapid from the	3/4	11/2	33
2 Partitions	36	2 V2	16%	I Peor	34	10%	33
7 Upright portitions	186	11/4	3.4	4 Door stiles	24	1 1/2	31%
Leaf repport	36	31/4	10 %	a Does stiles	36	139	14.9
1 Fold-over teel	2.	936	36	2 Shelves	4	9%	33
Dromer from	100	3	211	3 Ruppers	4	2/2	91/2
Drawer book	1,	230	27.7	1 Diswer separator	16	3	10%
2 Drower Lors	1/2	3%	12	2 Drawer fronts	34	21/14	16%
Degiver befrom				2 Drower bo ks	1/2	2	15%
(01y=00C)	154	17	27 %	4 Drower Ades	55	2 1/4	91/2
				2 Drower bonoms		- 110	
				(B) (WOOD)	104	ቀሣ	15%

Note: All distances are given in inches

Amerikaneous 5-16" half round from molding, 16-16" quarter-round or core molding for dones, 6 large knobs, 2 small broks, 3 pair hinges, 2 build catchet, 2 glass lights

A distinctive effect may be obtained by painting the interior a deep red, apple green, or deep blue to contrast with a pine or maple exterior, or a black or gray-blue to contrast with cherry. The back may be papered with a quaint pattern, if preferred



THE TRACKWALKER'S TRIUMPH

HOW NO. 98 ESCAPED DISASTER

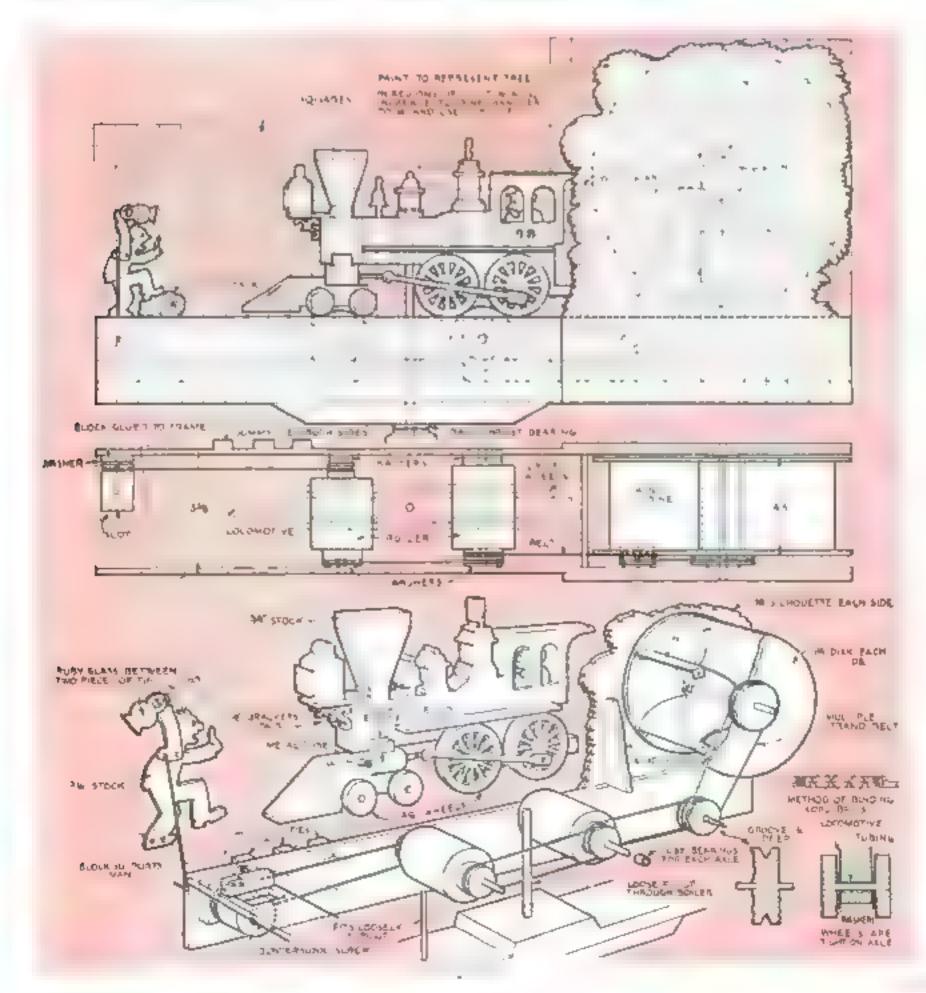
LOCOMOTIVE Weather Valle

ANIMATED by a wind turbine, this ingenious weather vane depicts an "Iron horse" of yesteryear slowing to a stop in the nick of time as a trackwalker waves his lantern to warn of a log on the track. Since the vane always keeps the turbine headed into the wind, the six curved tin blades develop plenty of power, because

those moving against the wind are shielded below their axis.

on wooden rollers driven by cord belts in deep V-grooves. Each belt is composed of a single length of strong string, the ends lapped and bound with thread. When doubled twice, these cords make four-strand belts which will grip in any weather. The ratio between the turbine pulley and the first drive pulley should be designed to suit local wind velocities. A pin fitted in the pilot, and also an extension of the pivot rod, stabilize the engine.

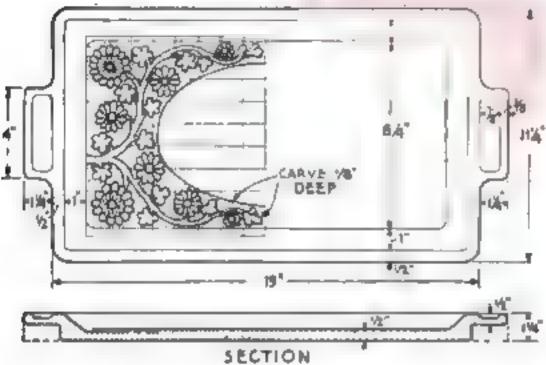
One arm of the jigsawed trackwalker is actuated by a rod connected to a pulley below. His tin lantern is pivoted at the hand. Rollers and sheaves are lathe-turned, and the locomotive and driving-wheel spokes jigsawed. Rustproof tubing should be used for bearings.—Hi Sibley.



Daisy Tray

Half the design is laid out on paper and turned around to make both sides uniform





LL hand carving decorates this attractive tray, which was hollowed 'rom a solid piece of poplar. The original was done entirely with gouges, even to the initial hollowing out of the stock, although this part of the work may be accomplished with mallet

and chisel, or with power tools, after the piece has been sawed to shape.

Lay out half the pattern on paper marked with 1" squares. Trace the design on one side of the tray, and then turn the pattern around and trace the other side. This makes it possible to get both sides exactly alike. Note, however, that in turning the pattern around, the lower left-hand corner of the first half of the design becomes the upper right-hand corner of the second half.

A set of small gouges of various sizes will make the carving easy. Leave the high parts of the daisies, leaves, and flower stems all the

same height to form a flat surface,

The original was carved with only the left hand, the designer, Carl Knatz, of Wapakoneta, Ohio, having learned this art and how to use his left hand after a stroke that paralyzed all his right side 14 years ago.

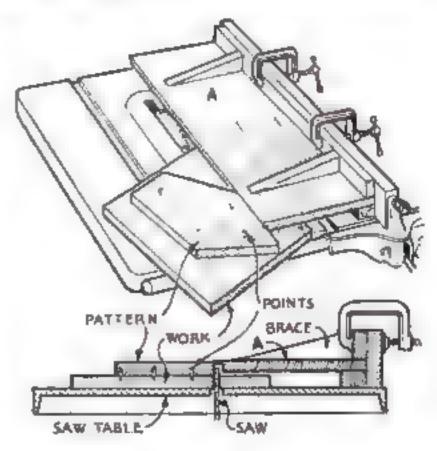
Wooden Jig Speeds Up Duplication of Parts on Circular Saw

OUR circular saw can be turned to mass production with the help of the simple homemade jig shown at right. Piece A, an oak board rabbeted on one edge to clear the saw blade, is clamped to the saw fence so that the pattern piece of the jig can be pushed against it, also clearing the blade.

This pattern, likewise of oak, is made the exact size and shape of the duplicate pieces to be sawed. The one shown is a chine gusaet used on V-bottom boats. Drill the underside with a half dozen small holes into which phonograph needles can be pressed firmly with the points out.

The pattern is placed on top of the work to be sawed and is tapped to drive the needle points in. Then the work is run through

with the pattern against the jig fence. Tilting the table occasionally will allow the waste to drop off.—William F. Crossy.





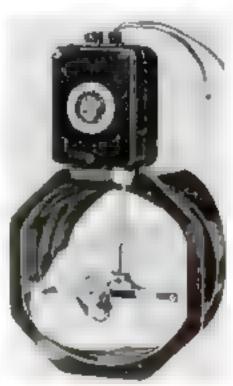
PLASTIC STORM SASH that is attached directly to a window frame is available for use where complete transparency is not needed—on such windows, for instance, as those in a bathroom, kitchen, basement, or attic, or on the upper section of windows throughout a house. While the new eash does not permit clear vision through a window, it is translucent enough to admit a certain amount of light, and is unobstrusive behind window curtains. The sash comes in sheets of four different sizes along with a length of adhesive weatherstrip tape. Fastened to the inside of a window frame, it sets up a dead-air space that acts as an insulator on the same principle as that of a regular storm sash.





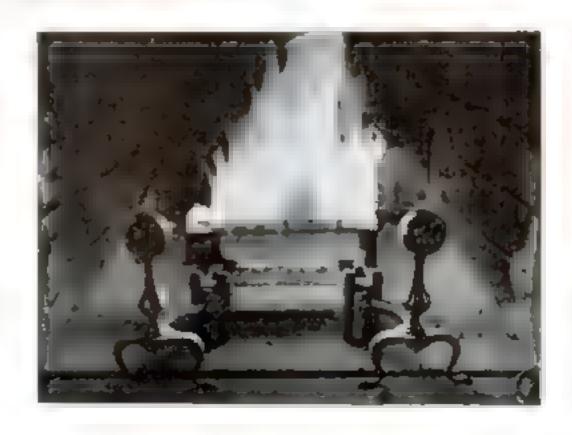
HOUSEHOLD-SIZE CONTAINERS of a masonry-waterproofing paint, formerly put up in quantities suitable only for professional use, are now on the market. This paint is manufactured only in white and gray, but it is as simple to apply as ordinary paint, thus making the water-proofing of a basement, or a concrete swimming pool, a job that can be done without the biring of expert help.

DRAFT IN A FURNACE FLUE is controlled automatically by the motorized unit shown at the right. Set into the flue and regulated in conjunction with the thermostat that controls room temperature, it arrests excessive chimney draft and air flow to conserve heat when the burner is cut down.



FIRES BURN WITHOUT KINDLING

when they are built of compressed logs like that shown in the fireplace at the right. They ignite quickly with the application of a match, give heat immediately, burn completely without breaking apart, and leave only powdery ashes. One log is sufficient for each fire. Two sizes are available, the larger burning for about an hour and a half. The logs consist of pressed fibers, non-explosive hydrocarbons, and other chemicals. They do not deteriorate in storage, and though they ignite readily, they will not catch spontaneously.



Special Jointer Setups

SPEED WOODWORKING CHORES

By EDWIN M. LOVE

HOUGH the small jointer in the average home workshop will probably find most frequent service in such routine work as surfacing stock and ordinary rabbeting, there are many special jobs in which it can substitute for other machines. It will take the place of a shaper, for instance, to joint, chamfer, and rabbet disks and segments of circles and to turn out moldings. It may be used for cutting end rabbets at an angle or

for forming tenons. These operations require only the simplest wooden jigs, all of which can be made at home.

How is a fig for circular work made? The body is an auxiliary fence consisting of a flat board attached to the regular fence. If the latter is mounted on the front, or infeed, table, a portion of the lower edge of the auxiliary fence should be jointed to clear the rear, or outfeed, table. With this are used two guides, one curved on top to the radius of the finished disk or segment, and

the other curved to the radius of the sawed blank, as shown in one of the drawings on page 146. Normally the difference in radius would be 1/16" to 1,8", the same as the depth of cut to be taken.

Rest the first guide on the rear table, lower the table until the top of the guide is tangent to the cutting circle, and screw the guide to the auxiliary fence. Then lower the front table for the required depth of cut, and screw the infeed guide to



Tenons are cut on a jointer in an operation similar to rabbeting, as shown above. The stop block is set high enough to clear the tenon. Rabbeting a segment (right) is done with a circular jig against an auxiliary fence

it as shown, making sure that the radiuses of both guides have the same center.

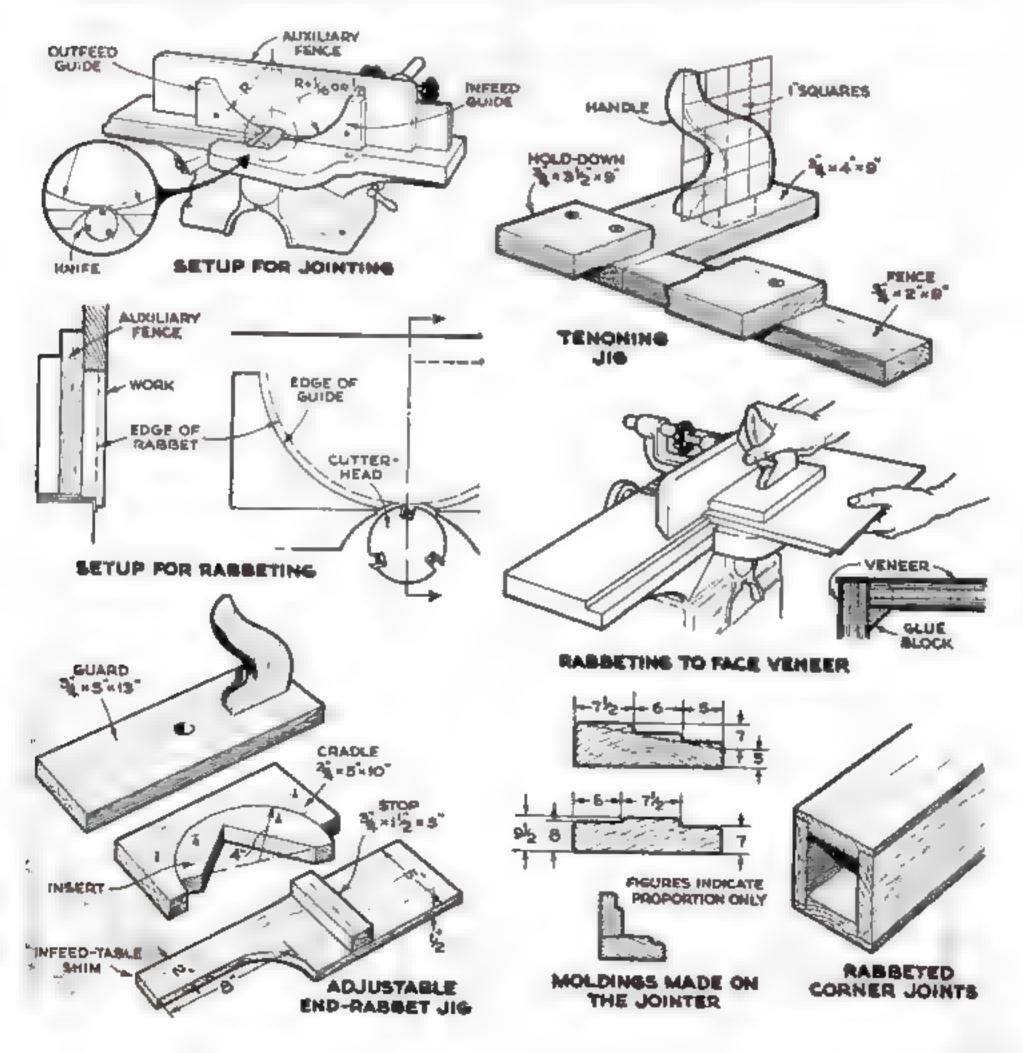
What are the steps in using the jig? Test the setup first with a scrap of wood. To joint a disk, set it in the jig in such a way that cutting will start with the grain of the wood, not against it, and rotate the piece until the dressed edge fits into the outfeed guide. Complete the cut with the piece aliding in this guide only. When jointing a segment, rest the work on the infeed guide and feed it against the cutter, transferring pressure to the outfeed guide as the segment slides onto it. This is essentially the same as straight jointing

In chamfering circular work, tilt the fence away from the cutter and place the guides in position with the corner, or arris, of the outfeed guide against the fence and tangent to the cutting circle. Lower the in-

feed table and adjust its guide to cut the chamfer with one pass. For bevel jointing, modify the setup by beveling the bottom and curved faces of the guides at an angle parallel with the tables. Time can be saved by sawing the blank at the same angle.

How is circular work rabbeted? Joint all the pieces first; then substitute for the jig infeed guide one having a radius equal to that of the outfeed guide. Lower both tables to the depth of the rabbet, adjust the fence for the width of the cut, and try the setup with a piece of scrap. The inner side of the piece will be rabbeted since the flange will project beyond the edge of the cutter, as in a photograph on page 145.

Can end rabbets be cut at an angle! An adjustable jig for this work is shown in one of the drawings. The end of the stock to be rabbeted fits in a notched semicircular in-



sert seated in a cradle that is acrewed to the underside of a guard, or mitten. This insert can be locked in any position by screws driven through it into the guard, thereby varying the angle at which rabbets may be cut. A peephole in the guard over the corner of the notch permits the operator to see that the work is properly seated. An L-shaped shim with a permanently attached stop is clamped to the infeed table, its open section providing space for the work, which rests on the table, to travel to the cutterhead. The shim is slightly thicker than the depth of cut, and permits the cradle and insert to slide to the outfeed table without coming into contact with the cutter.

If only one such rabbet is to be cut, or several are to be cut at the same angle, a somewhat simpler jig may be made by notching a guide block to receive the stock. In this case also an L-shaped shim is used. The guard may be a plain strip of wood with a peephole over the corner of the notch, as shown in one of the photographs below. Stop blocks clamped on the table or fence will limit the forward and backward motion of the work, thus shielding the operator's hands from the cutter.

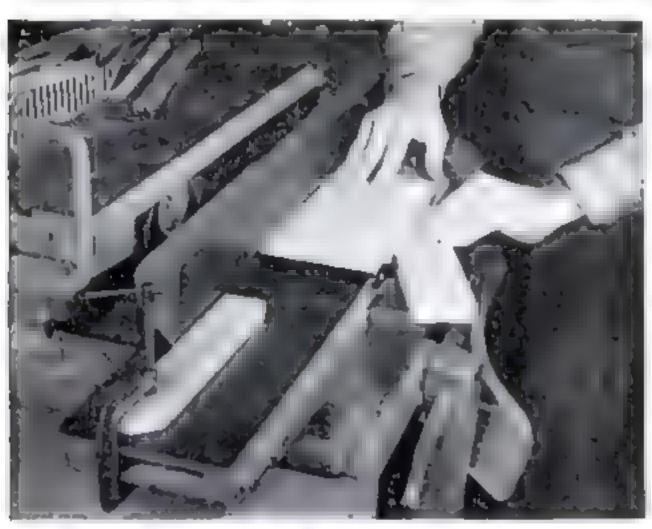
What jig is used for cutting tenons? Attach a fence at right angles to a mitten by means of a wider piece screwed to both, as shown in a drawing, and use this to hold down the work and to push it. The end of the work slides against the machine fence, as in a photo on page 145, thus locating the shoulder accurately. A forward stop block prevents further travel after the work has passed over the cutter.

How are corner-joint rabbets proportioned? The width of the rabbet should be

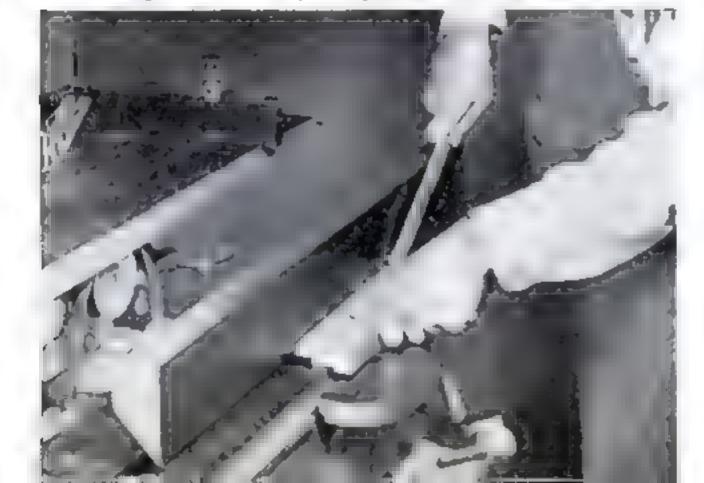
greater than the thickness of the mating piece so that, after assembly, the projection can be planed or sanded flush, A depth of two thirds the thickness of the stock provides good gluing surface and, if desired, permits nailing from both directions. Deep rabbets, and consequently less end or edge grain showing, may often aid appearances, for one edge will show two kinds of grain, which may be noticeable even in painted work. The limitations of the jointer must, however, be taken into consideration.

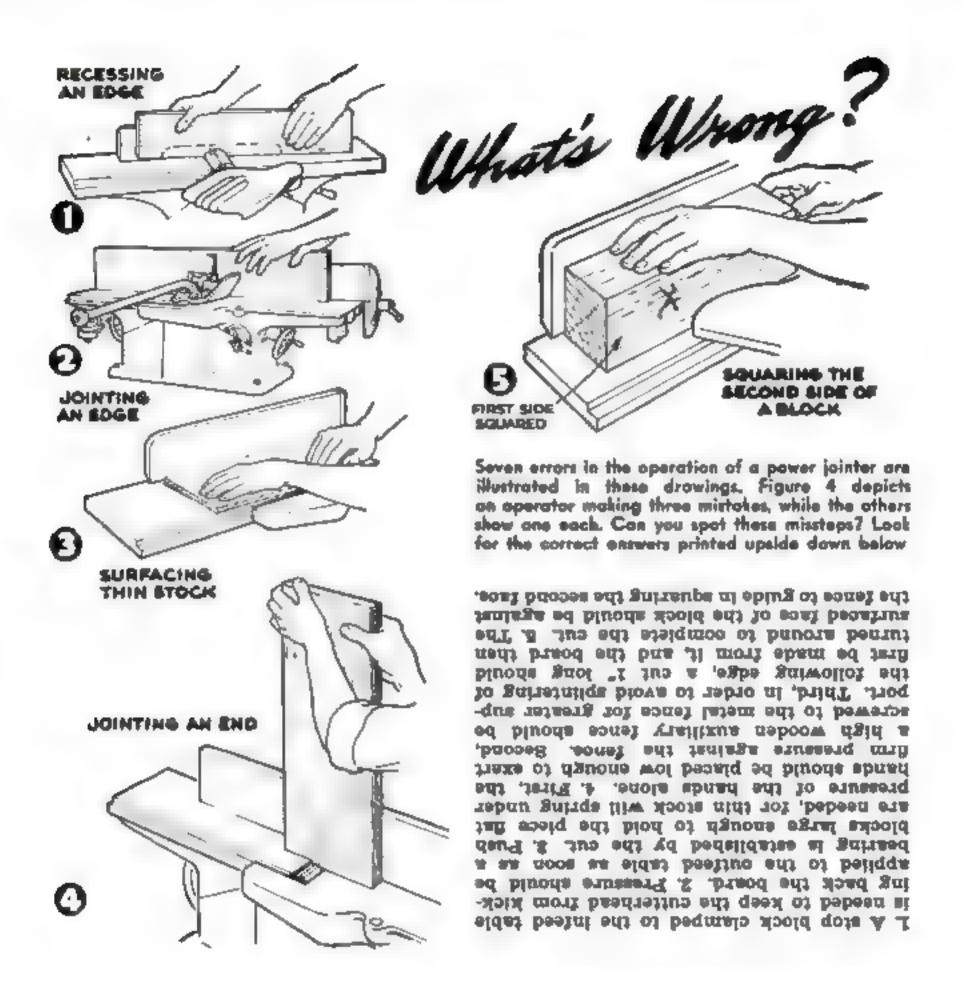
A rabbet joint is a valuable substitute for mitering when veneered plywood is used. The depth of the rabbet is carried to the back of the face veneer in two passes over the cutter, the second being a light cut to avoid splitting the veneer. A mitten should be pressed firmly on the top of the workpiece to hold the veneer against the knives.

Are moldings possible on a jointer? A series of rabbets judiciously spaced, with the corners left square or rounded by hand, will make a pleasing molding. Some suggested moldings are shown in a drawing, with proportions in keeping with good design,



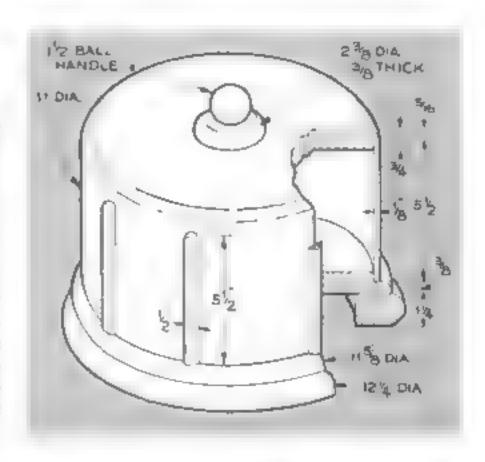
End rabbets and tenons are cut at an angle with the aid of a notched guide into which the stock fits. The top guard protects the hands. Moldings can be made by cutting successive rabbets on the workpiece

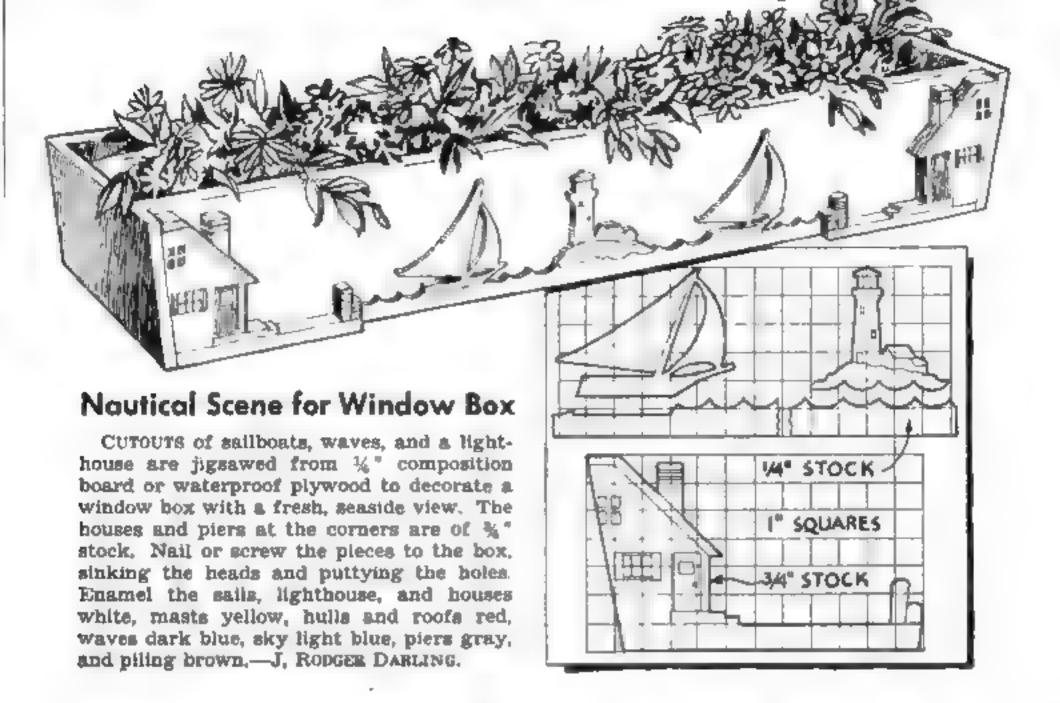




Parts Finished on a Jointer Form Cake Tray and Cover

THE circular parts of this cake server are formed on a jointer with the aid of jigs described in the article beginning on page 145. After shaping and rabbeting the two sections of the tray, as well as the top of the cover, chamfer the corners before rounding them off by hand. Make the wall of the cover in seven panels with the grain vertical. Assemble the panels into a strip by gluing balves of dowels over the joints and bradding from the inside. When the glue has dried, wet the outside, being careful of the glue if it isn't waterproof, and nail the strip to the top, bending each panel separately. Use a wood ball and disk for the knob.—E. M. L.





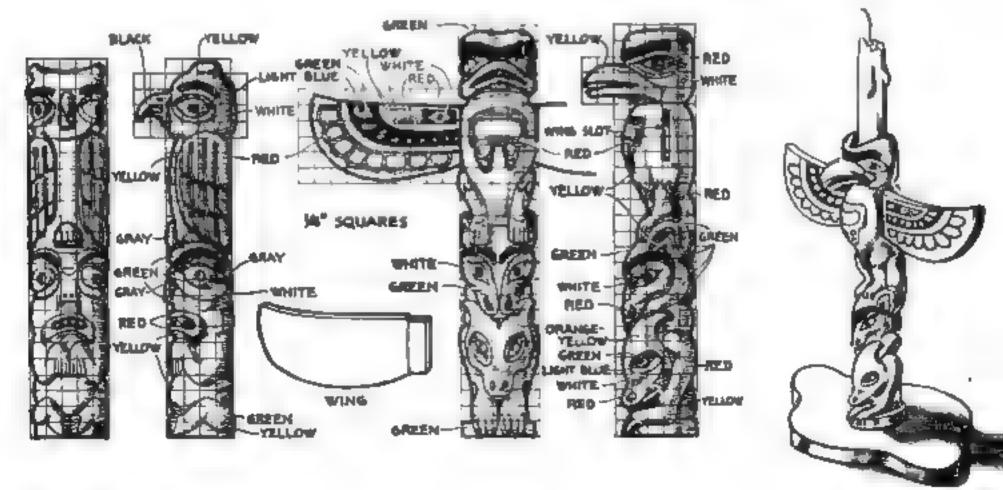
Picturesque Candle Holders Carved Like Indian Totem Poles

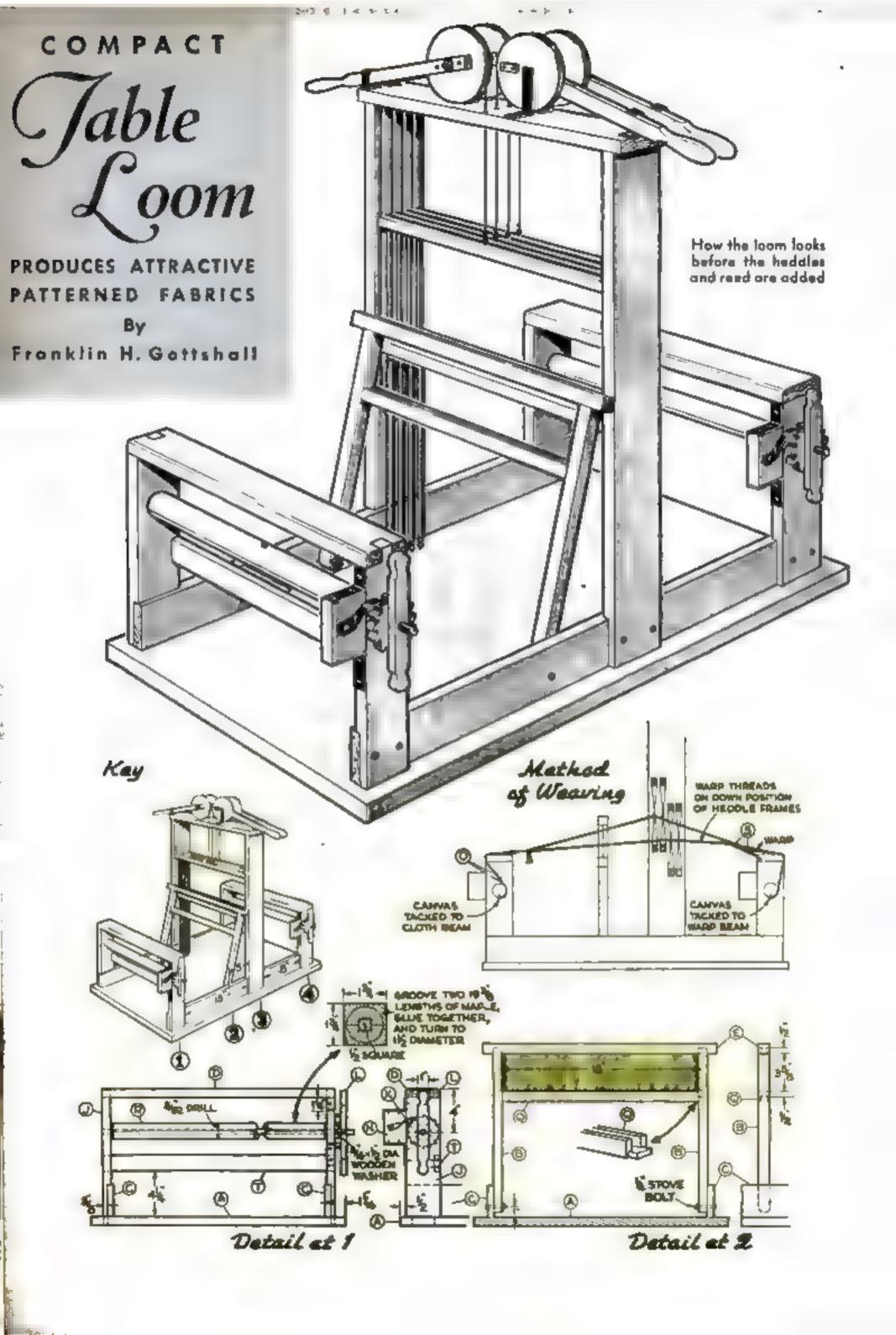
USED in a den, a home with a Western atmosphere, or a room in which other curios form part of the motif, these totem poles will add their decorative touch. They are carved from 2" by 2" by 6 1/2" blocks of white pine or basswood, and are bored to hold a candle in the top of the head.

Draw the designs on the wood, and then carve the figures with a knife or carving tools. The wings for the holder at the right

are sawed out with tenons to be fitted and glued into mortises at the sides of the figure. A base of the proportions indicated will be a safeguard against a holder tilting with a lighted candle. One of each figure will form an attractive pair, or two matching pairs may be made.

Paint as suggested in the drawings. If show-card colors are used, finish with a coat of clear varnish.—GRAY WOLF.





It's Easy to Learn How to Weave on This Simplified Loom

A PROJECT that will serve as an introduction to the ancient art of weaving, this hand loom is both entirely practical and compact enough to fit on a small table. Many attractive things—scarves, neckties, handbags, table runners, even blankets—can be made from the beautiful patterned fabrics it weaves. The cloth produced is up to 18" wide, while finished products requiring wider material may be made from panels stitched together. Though slower than a treadle loom, it is less bulky and simpler to build.

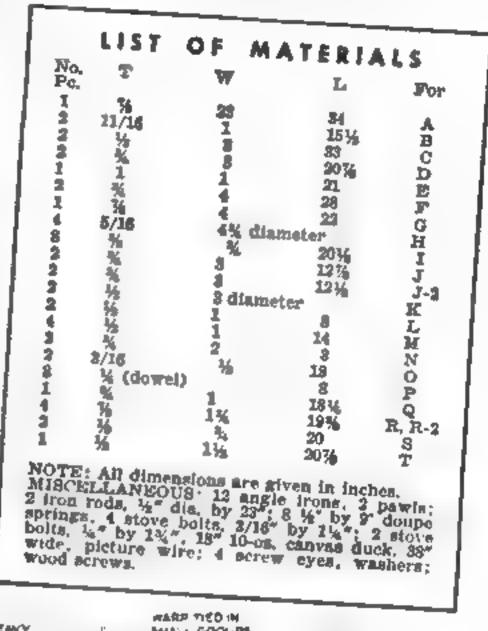
A brief consideration of weaving principles may perhaps make the construction clearer. Space will not permit discussion of how to weave, but there are many books on this subject. A glossary of common loom parts and weaving terms will be found

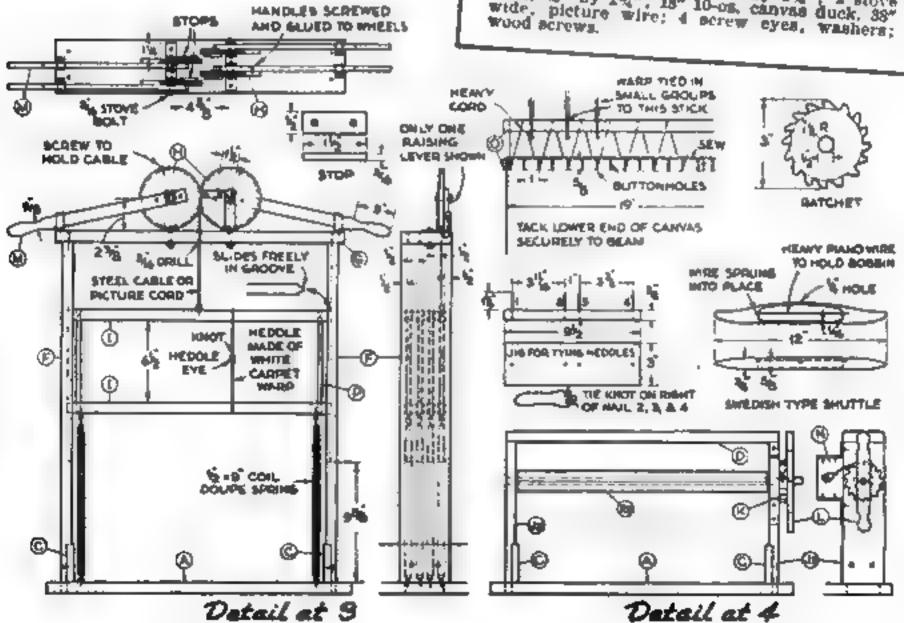
on a subsequent page.

Basically, a loom is a machine for separating certain groups of warp or lengthwise threads so that a shuttle may carry the west or traverse threads through. The shed, a triangular passageway between groups of warp threads, is obtained by pulling down one or more of the levers (M) at the top of the loom. This raises the heddle frame (I and P), an open rectangular framework on which is placed a series of looped cords or heddles, knotted so that a small eye occurs in the center of each. Since every warp

thread passes through a heddle eye, it follows that when a heddle frame is raised, it also carries upward only the warp threads which pass through the heddle eyes on that particular frame

The pattern is determined partly by the manner in which the warp threads are grouped on the heddle frames, partly by the





sequence in which the levers are raised and lowered during weaving, and partly by the color of the west threads used in the shuttles. The number of shuttles needed is determined by the number of colors to be woven into the cloth

As the shuttles carry the west threads through the shed, they are packed into the cloth as tightly as desired by the beater, (B, Q, and E). This consists of a pivoted frame which carries the reed, a series of parallel steel wires mounted in their own frame. Rather than to attempt to construct a reed, you will find it simpler and more satisfactory to purchase one or more commercial ones.

In weaving terminology, the dent of a reed is the number of wires per inch; a 17-dent reed has 17 wires per inch. If you wish to weave a variety of patterns, it is desirable to have several reeds. A 17-dent reed and a 24-dent reed will do for a starter. When quite fine warp threads are used, it

is possible to pass two through each dent of a 17-dent reed, thus giving 34 threads to the inch. The 24-dent reed, on the other hand, will permit use of medium-weight warp, while the 17-dent reed, threaded normally, will take fairly coarse yarn.

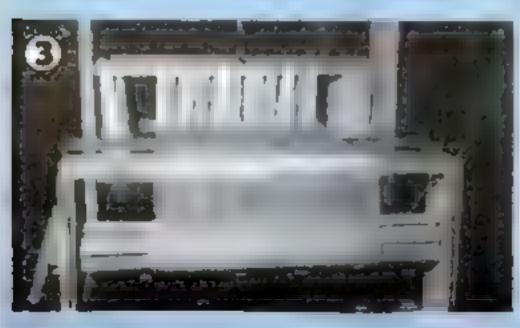
Heddles, made of cotton carpet warp, are first waxed (beeswax is best, though paraffin can be used) and then tied with the aid of a jig. This is made by driving four tenpenny nails through properly spaced holes drilled in a board, and then cutting their points off. Since every heddle should be exactly alike, the nails must be perpendicular to the board and not too long, as otherwise they might bend when the heddles are tied. About 1,000 heddles will be needed, 250 for each heddle frame. The them on the jig in groups of 25 and bind them with string until they are stripped on a heddle frame.

The loom consists of four main parts: the cloth beam, with its supporting and arresting parts (designated 1 in one drawing):





- Here the loom has been threaded up and a short length of finished cloth is visible at the left of the beater
- 2 When one of the levers is raised, the pulley to which it is attached lowers one of the headle frames beneath
- 3 Some flat sticks or battens on the warp beam help keep the warp even, while other sticks are fied to the rai
- 4 The sats that the tangues of the heddia frames run in can be extended all the way up to the top if you prefer





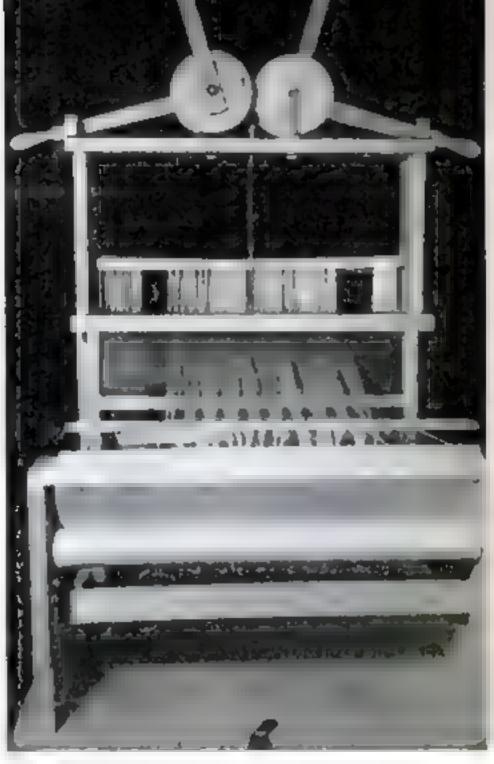
the beater (2); the harness, which includes heddle frames, doupe springs, and the elevating mechanism (3); and the warp beam, with its supporting and arresting parts (4). Although the construction is indicated in the drawings and the dimensions are given in the list of materials, certain particulars merit consideration.

Use hard maple or similar wood in making the loom. Glue up a piece 23" by 34" for the base and into this cut six mortises for the uprights. Note that the warp beam and the cloth beam are mounted in almost exactly similar supports; the only differences are that the warp beam does not need the extra bracing rail, and that the rail on top is attached by screws rather than by mortise and tenon joints.

A good way to make the beams (R and R-2) is to groove two pieces of maple to take the iron rod (Y), glue them together, and turn to $1\frac{1}{2}$ " diameter. Then drill two 5/32" holes in the rod for the steel pins or nails which anchor the beam and tension lever to the rod.

A length of canvas should be tacked securely to the cloth beam. Two sticks (O) and a cord lacing provide a means to attach the warp threads. When the warp is placed on its beam, a series of sticks is also laid on, as shown in one photograph, in order to provide an even, regulated tension on each warp thread. Two other sticks are shown in the same photo and at S in a drawing; they are also helpful in feeding the warp properly.

The beater consists of two stiles and two rails for holding the reed. Since it will frequently be necessary to change reeds, do not glue these parts together. Make certain that the heddle frames slide smoothly in their grooves. The tongues on the ends of the heddle sticks (I) must be trimmed to permit this, and the dowels (P) must be of an identical length and perfectly straight.



This view shows the loom from the cloth-beam end. The worp is in place and ready to weave

Cut and bind the picture wire for the cables so that when the levers are down, each heddle frame is raised to exactly the same height. Attach a small stop to each pulley to keep the cable taut when a lever is raised. The metal brackets which support these pulleys should be just loose enough to permit the lever to be swung away from its latch when a frame is to be lowered.

GLOSSARY OF LOOM AND WEAVING TERMS

Bearer - The batten or frame, holding the reed, for driving the west into the cloth.

DRNT-One of the fine wires composing the reed between which warp threads pass; also, the space between two such wires.

Double Spring—The spring used to return a raised heddle frame to position.

HARNES — The part of the loom which includes the heddles, heddle frames, and the mechanism for raising and lowering them

Heppin One of a series of parallel doubled cords, tied with a small eye or loop in the center, through which a warp thread passes.

Hebotz Fanne-One of the open vertangular frames on which the heddles are located

Resp—A series of parallel fine wires mounted in a frame and held in the beater for driving the sceft into the cloth.

Sump—The triangular passageway between groups of warp threads through which the shuttle passes

Warr—Threads which run longitudinally in the loom and in the cloth woven

Werr—Threads which run transversely in the loom and cloth, woven in with the shuttle. Sometimes called woof.

Sawdust from the blade of the coping saw falls into a sliding tray as the bedridden patient cuts scrolls in stock supported by a bench pin clamped in a vise. The vise can be attached anywhere along the bench. How the bench folds is shown below

By FRANK HEGEMEYER



BED WORKBENCH

Can Be Constructed at Home to Put Craftwork
Within Comfortable Reach of Convalescents

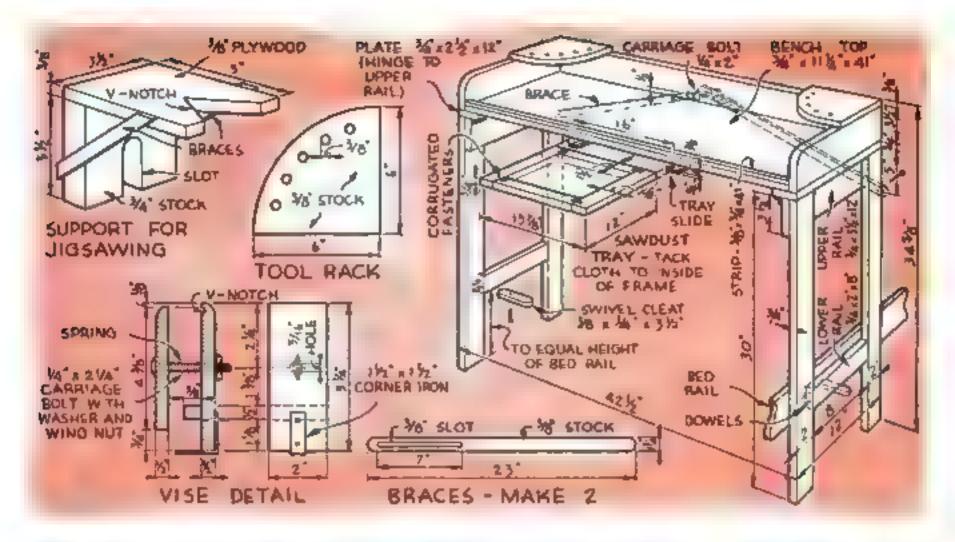
ITH the aid of this simple bed workbench, the tedium of recuperating from an illness can be greatly lightened for any patient whose hobby happens to be craftwork. It is a sturdy bench intended especially for ailing hobbyists who fashion objects from plastics and other light materials, and for model builders.

Designed so that it can be folded compactly and stored in a small space, the bench is constructed mostly of standard %" pine stock, and can be made throughout with hand tools. It can be adapted to fit a bed of any size, but the dimensions in the drawing are for a bench to fit a bed with side rails 41" apart and 8%" above the floor.

As a starting point, cut the length of the bench top to conform with the width of the bed measured from the outside of its rails. Any deviation from the 41" dimension will affect the two rear sliding braces and their

slots, and these should be changed accordingly. Plates are nailed at each end of the underside of the top, and the legs are hinged to them, after which the back and side rails are nailed to the top. The top leg stretchers are also nailed in place, but the lower stretchers are doweled, as in the drawing. To the lower stretchers are attached swivel cleats that swing under the best rails to keep the bench from tipping.

Closely woven cloth, 12" by 16", is tacked to the inside edges of the frame of the sawdust tray, which is held in slides under the bench. One drawing gives dimensions for a wood vise that can be attached anywhere along the bench, and another shows how to make a support for scroll sawing that can be held in the vise. The vise, the sawing support, and the bench top are given a coat of linseed oil or clear varnish. The remainder can be painted or stained.



Either round or square work can be held solidly in this light, conveniently adjustable wood vise

Cloth tacked to the frame of the sliding sawdust tray forms an apron to keep litter off the bed





MARCH CHECK LIST

[SHIPSHAPE HOME]

- 1. Inspect for termites in basement posts, sills, and frames.
- 2. Brush down cellar walls and ceiling, and paint or whitewash them.
- 3. Clean inside woodwork and walls, and renew paint and paper where necessary.
- 4. Clean screens. Brace corners, patch holes, and touch up paint.
- 5. Examine the underside of the roof for leaks, and mark them for repair.
- 6. Make temporary roof repairs where urgent as a precaution against spring rains.
- 7. Repair, sharpen, and paint garden tools.
- 8. Clean and repair garden trellises, arbors, and pool.
- 9. Repair and straighten fences and gates to make ready for painting.
- 10. Inspect tops of window and door frames for bad flashings.

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HOW TO DRILL ROUND WORK

Single-Job and Production Methods of Locating Holes in a Pin

RILLING a hole straight through a diameter of round stock can be made a simple job, but unless care and judgment are exercised, the hole is likely to run out on the far side at an angle. When a large number of pins are to be drilled, it is economical to build a drill jig in which they can be placed. The drill is then accurately guided by hardened bushings. If only a few are to

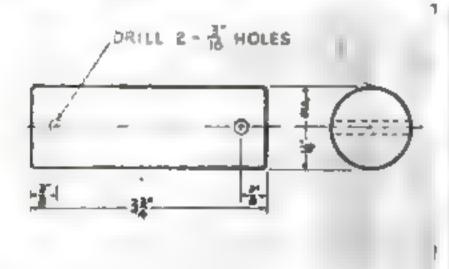
This is a typical job—two 3/16" holes are to be drilled straight through a small steel pin without running off from the diameter. Tolerance

on location and direction of the holes is 1/32"

be handled, each pin is laid out, prickpunched, center-punched, and then clamped on a V-block or a piece of wood for drilling

Both of these methods are described fully in a motion picture produced by the United States Office of Education and distributed by Castle Films, Inc. Important steps in the work are illustrated in the accompanying views taken from the film.

2 With the pin whitewashed to show markings, a longitudinal line is scribed with a key-seat rule. Similar in cross section to a right-angled channel, the rule aligns itself with the pin axis



STEEL PIN





3 Cross lines are next drawn %" from each and to intersect the longitudinal line. Set the combination square for 3%" and hold the face of the tongue firmly against the end of the pin



5 Enlarge each prick mark with a center punch to make a depression big enough for starting the drill. Hold the center punch vertical, turn it until it centers, and then hit it a solid blow

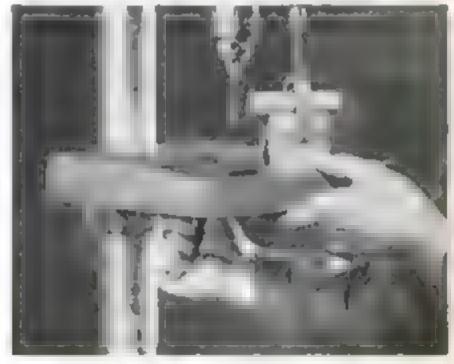
7 Set the stops of the drill-press spindle so

the pin and end it just after it goes through

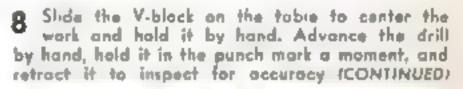
that the drill will begin its travel 1" above

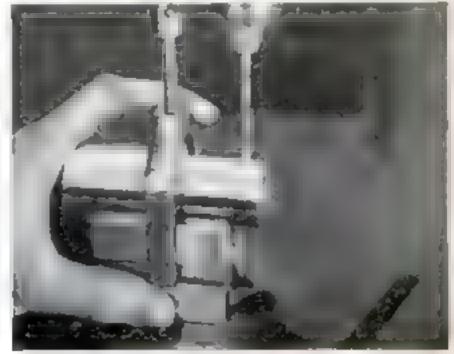


4 Mark these intersections with a small prick punch held vertical and tapped lightly with a hommer. Arrange the pin on the V-black so that the end being punched will have a solid bearing



6 Clamp the pin rigidly in the V-black with the end overhanging enough to keep the drill from morring the black. Lock the drill-press table at a height where the drill will go through the pin



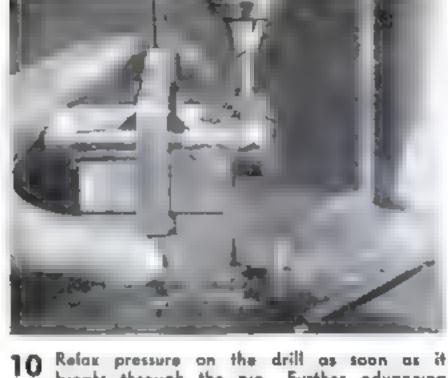


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9 Repeat this until you are sure the drill has no tendency to run to the side. Use cutting fluid when drilling, squirting it into the hale each time the drill is withdrawn to remove chips



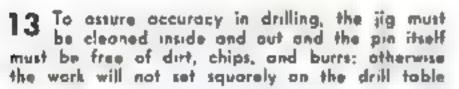
10 Relax pressure on the drill as soon as it breaks through the pin. Further advancing should be done with care to keep the flutes of the drill from snagging on the burrs and breaking

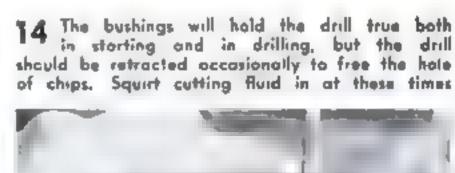


17 After drilling each hole, clean the bottom of the V-black and brush the chips from the table. Unless the black is level, the drill will run off and the hole will not be a true diameter



12 If the tob calls for a large number of pins, tedious laying out can be avaided by use of a jig fitted with hardened bushings to guide the drill at the points where holes are to be made









SHOP



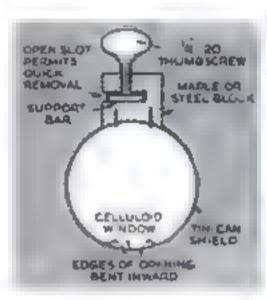


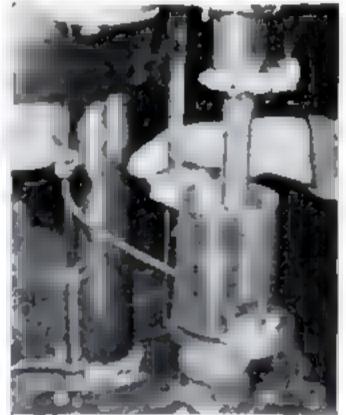
CLEANING COUNTERBORED HOLES can be done quickly with the aid of several tube brushes and a small motor. Brushes of the type shown have twisted wire handles and sell for a few cents. An adapter is made by drilling one end of a short piece of brass rod to fit the motor shaft and the other to ac-

commodate the shank of the brush. For best results, cut the brush handle off to leave a ½" shank. Use small setscrews to lock the adapter to both the shaft and brush. The speed of the motor should not be so great as to cause the brush to whip to the side and bend.—W. E. B.

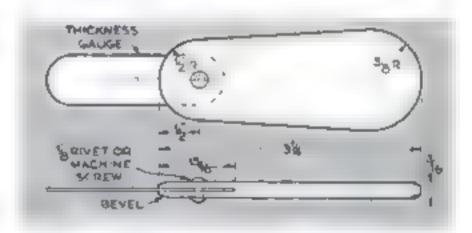
A CUTTING-FLUID SPLASH SHIELD made from a tin can and other odds and ends will prevent spattering of the coolant by spiral chips thrown off during operation of a drill press. Cut the top and bottom from the can, and cut a slot to permit insertion of the

cutting-fluid tube. A 1" wide rectangular opening, made near one end and covered with a piece of celluloid, will form a window through which the lower part of the drill bit will be visible. Nail the can to a hardwood block, slotted and fitted with a thumbscrew. This block is vertically adjustable on a flat steel bar that is bolted at the top of the drill-press head.—W. E. B.

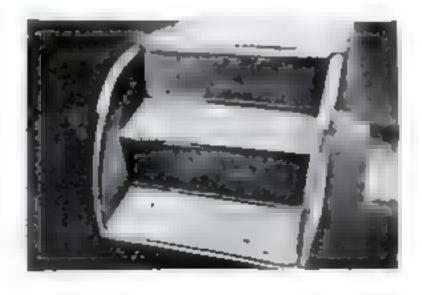




BROKEN FEELER GAUGES, almost certain to be lost if allowed to remain loose in a tool drawer or chest, may be salvaged for re-use if they are fitted with individual handles. Plastic, fiber, composition board, or wood, cut to the shape shown and slotted with a fine saw, will serve satisfactorily. If the thickness of the broken gauge isn't readily legible, be sure to mark it clearly on the bandle.—Louis Filas.

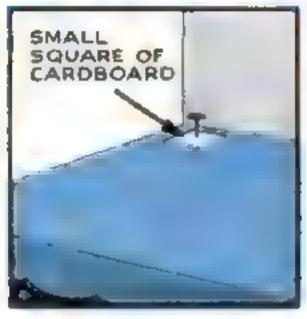


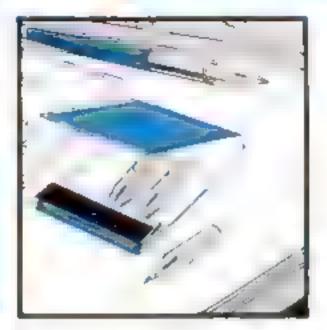
SUBSTITUTES FOR STAIR TREADS of the steel type once turned out in quantity but now hard to obtain can readily be fabricated from ordinary metal lath. This material is spot-welded to flat stock, resulting in a firm, nonslip tread, such as that shown at the right. The treads are suitable for use on vehicle running boards, on fire-escape stairs, on shop and office-building stairways, and in other places where a secure footing is desired.—Bruce Macintosh.



HERING THE HOME



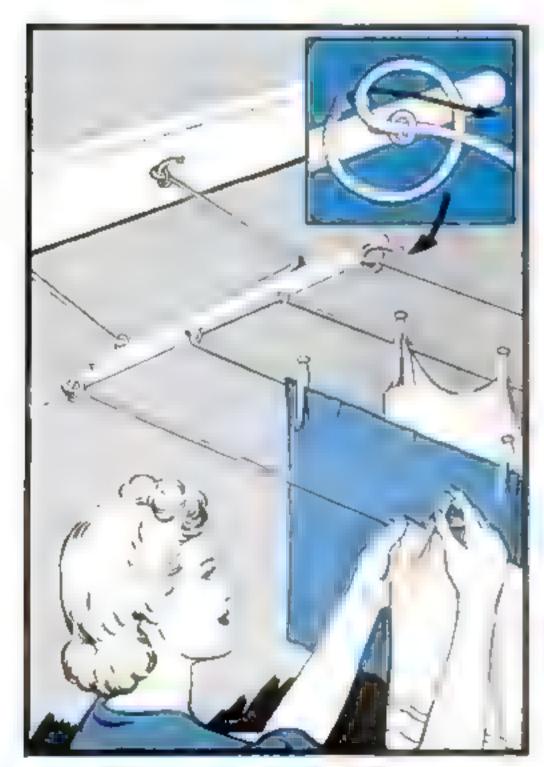


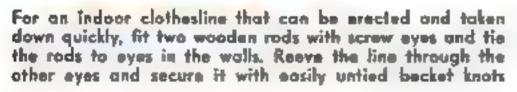


Taping a tight-fitting electric plug, as shown above, will allow it to be pulled from an outlet without undue strain on the cord

Shelf paper cannot be cut by the sharp heads of carpet tacks if small squares of cardboard are used as washers to seat the tacks

Pen points will not be scattered around a desk drawer if they are inserted in the folded butt end of an empty paper-match holder





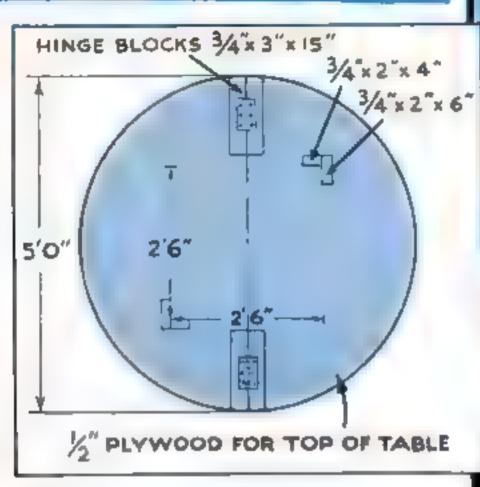


Thumbtacks in each of the lower corners of the back of a picture frome provide on air space between frome and wall, and keep a dust line from marking the latter

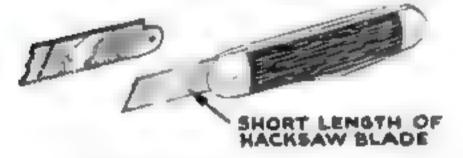


Melted paraffin, applied with a cloth and rubbed in a thin film over the incides of breadbases, wastebaskets, and other metal receptocles, will keep them from rusting

SHIPSHAPE



This folding table top will double the capacity of a bridge table to be used for other games. It may be made af plywood, or a handsome job may be turned out with a fine veneer. L-cleats that fit around two table corners hold the top in place



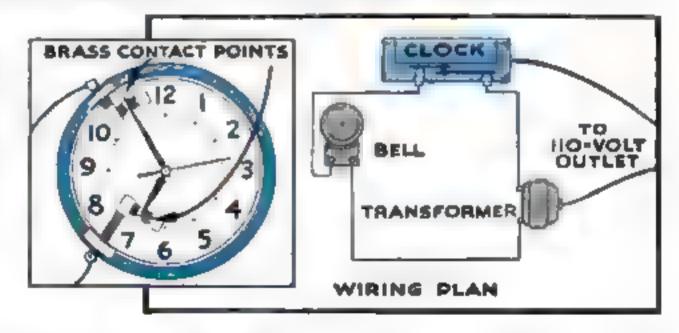
The broken blade of a knife can be replaced with an end of a hacksow blade, useful for many jobs around the house. Punch out the pin of the old blade and insert the saw between thin washers to take up slack; then rivet the pin back in place



DOTTED LINES INDICATE TOP OF BRIDGE TABLE

Smokers who prefer pipes with threaded stems can use a bit of cardboard to true up the stems when they tighten to a position in which they are at the wrong angle to the bowl, Slip on one or more cardboard shims, tighten, and trim them all around

To speed up the work when driving a number of screw hooks, put a screw eye in the chuck of a hand drill, using the drill as a wrench with the eye engaging the hook. Reverse the process and employ a hook in the chuck when eyes are being driven



Any clock can be wired to give a dependable alarm. Use dry cells at a doorbell transformer, not a toy transformer, insulate all parts from the clock with tape. Contacts on the clock face are L-shaped strips of brass, attached with tape, and humped so that the hands will just slide over them. That for the minute hand is outside the sweep of the hour hand

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CHECKING AND ADJUSTING

SEED DRILLS

PREVENTIVE MAINTENANCE GUARDS AGAINST WASTE AND ASSURES WELL-PLANTED ACRES

By E. W. LEHMANN

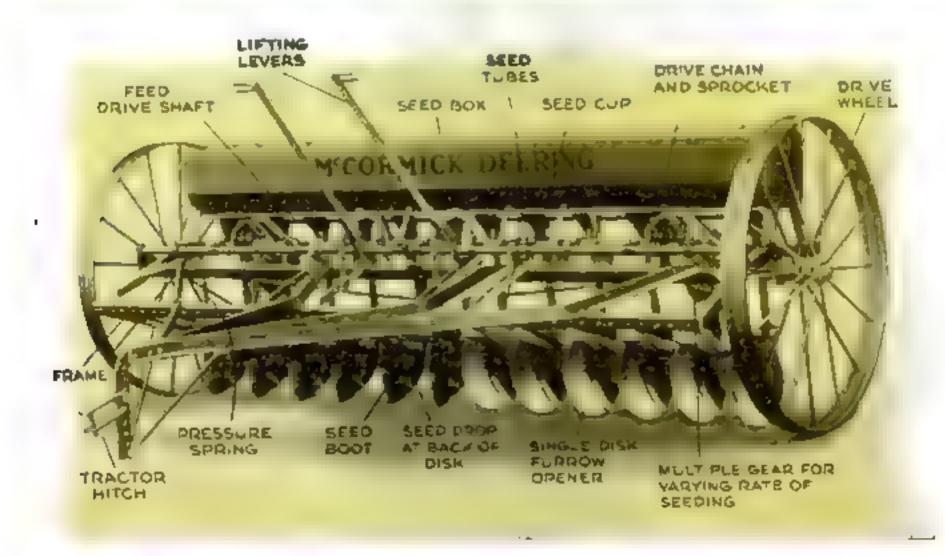
Head of Department, Agricultural Engineering, University of Illinois

ROBABLY no farm machine will give greater returns in the way of long life and satisfactory operation than will grain and grass-seed drills when they get a reasonable amount of attention at the beginning and end of each season. Such preventive maintenance, carried even to the point of using just the right grades of grease and oil, may protect many an acre from haphazard seeding, and is sure in any event to recompense the farmer liberally for the thought and time devoted to it. Reduced yields because of poor stands and poor spacing are bound to result from drills operated inefficiently just as surely as they do from old-fashloned hand sowing.

The chief parts of a drill are the seed box, the feed cup and feeding device, the seed tube and boot, the furrow opener, the covering devices, and the supporting frame, which is mounted on two wheels and has a hitch for horses or a tractor. Feeding devices are

located at the bottom of the seed box and, together with seed tubes, seed boots, and furrow openers, they are spaced either 6", 7", 8", or 10" apart in grain drills. Drills for planting clover and grass seed have feed cups and furrow openers spaced 4" apart. By operating only every fourth feed cup, a 7" drill can be used for drilling soybeans in rows 28" apart, and in the same manner an 8" drill can be employed for putting in rows spaced at 82". Many grain drills are equipped with attachments for drilling grass seed and fertilizer.

Two principal types of forced-feed devices are the fluted-cylinder feed cup, with which the rate of planting can be varied by exposing more or less of the cylinder to the seed, and the double-run, ribbed-center feed wheel. The speed of the latter can be controlled so as to regulate the rate of planting. One side of such a feed wheel is for small seeds and the other for large ones. This type of feed is held better by many farmers for drilling soybeans, peas, and beans than the fluted cylinder, while the cylinder is often preferred for small grain such as wheat, oats,





Pulled behind a tractor or horses, this typical grain drill sows a field evenly and produces a good stand

and barley. Furrow openers on drills are in the form of a shovel, of a curved runner opener like those on corn planters, or of single or double disks.

Grease, oil, and kerosene are all used in lubrication, each for a specific part. Latemodel drills are equipped with hydrauliclubrication fittings on axle bearings, countershaft hangers, and disk bearings. Only a grease gun is good for these. Machine oil

is needed for the sprocket bearings and lifting levers, and kerosene for the feed cups.

Examine the chain tighteners and, if the drill has not been used for some time, be sure there are no obstructions in the feed cups. See that all parts are running freely before filling the seed box and taking the drill to the field.

To assure a uniform depth of planting, with proper coverage of the seed, adjustment is made either on the lift lever or on the pressure-adjusting lever. On hand-lift drills this adjustment is ordinarily obtained with the lift lever, while on power-lift drills the adjustment for depth is made by means of the pressure-adjusting lever

Should the feed-regulating lever be out of adjustment, the rate of planting can be definitely established only by a test. After making an adjustment calculated to sow the

desired amount of seed per acre, the accuracy of the adjustment can be checked by the following method.

First, determine the number of revolutions a drive wheel will make in the planting of an acre. The number is dependent on the diameter of the wheel and the width of the drill. For example, the 36" wheels of a 10' drill will make 460 revolutions in the planting of an acre, or 115 for one fourth of an

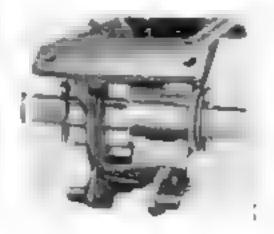
acre. On a drill of the same width, 50" wheels will make but 330 revolutions per acre, or 821/2 for a quarter acre.

Second, decide upon the rate of planting in pounds or pecks per acre. This consideration is usually pretty well established locally for each crop. Then, if 45 lb. of oats are to be planted per acre, you will know that 11½ lb. should pass through the feed spouts with every 115 turns of a 36" drive wheel, while the same rate of planting should result from only 82½ of a 50" wheel. With this data, a conclusive test is easy to make.

Jack up the drill so the drive wheels are free. Place the oats in the seed box and set the feed-regulating device at the planting rate of 45 lb., or six pecks, per acre. Set the surveyor or land measure at zero. Use paper bags to collect the grain from each seed tube sep-



Forced seeding is done with double-run wheels, like the one above, or fluted rolls, below, mounted in a single row. The rate is adjustable



arately, and revolve the drive wheel the number of turns required for the test. Then note if the same amount of seed is deposited in each bag, and also if the total amount in all the bags is sufficient to plant an acre at the rate desired. Some drills are equipped with a divided feed shaft, and on these each half of the drill should be tested separately.

If too much seed passes through the drill, the feeding mechanism should be reset accordingly. If the amount discharged by the seed tubes is not uniform, the tubes may either need adjustment or be badly worn. Sometimes when too little seed is discharged, the feed cups or tubes are plugged up, and the remedy is obvious.

As with other machinery, the first step in overhauling a drill is a thorough cleaning of all parts. Certain fertilizers may be injurious to the metal of drills having fertilizer attachments. Never store a drill without thoroughly cleaning out all fertilizer.

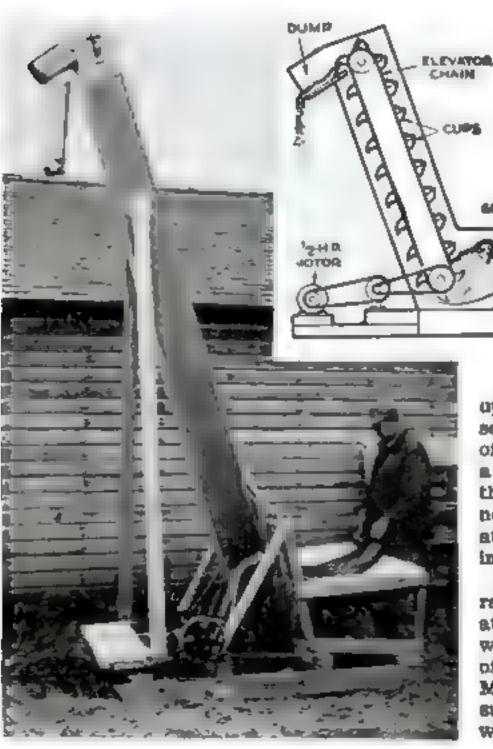
Support the drill on carpenters' horses and turn the drive wheel to see if the feed shaft and all other parts turn freely. Remove the wheels from the main axle, check

the drive pawls and springs for looseness, and observe the condition of the bearings. Take out the seed tubes, and clean and oil the feed cup with a light oil or kerosene. Replace worn chains and sprockets. Raise the furrow openers and test each for looseness at the points of connection. Unevenness in seeding can be avoided by keeping furrow-opener connections tight.

Install new pressure springs if the old are weak or broken. Also adjust the balance springs on the lifting lever so as to help support the furrow openers when they are in the "up" position, as well as to press down on them when they are in the "down" position. Remove the disk openers, and clean and lubricate the bearings, replacing worn ones. Adjust the scrapers so that they conform to the disk surfaces. The right kinds of grease and oil are essential. Use only grades that are recommended by the implement manufacturers.

It is well also to repaint painted surfaces of any implement when a repair job has been completed. This adds greatly to the life of the metal by preventing rust.

Portable Grain Elevator Built from Parts of Old Combine



TAKING the two elevator chains and the buckets from a secondhand combine threshing machine, Keith Rhodes, of East Garland, Utah, fastened them into a long continuous chain for use in this wheat elevator constructed mostly of ordinary lumber. Scrap pieces of plywood form the elevator-shaft bousing, and the whole unit is light enough to be moved by truck. It is employed in holsting loose grain into a granary, truck, or box car.

Grain is dumped into a 30" by 56" receiving bin, accoped

up into buckets when the elevator chain is set in motion, and poured out at the top of the 14' high shaft. Power is supplied by a small motor mounted on the shelf near the drive wheel. This wheel is in turn connected by chain drive to a second wheel at the base of the elevator chain, as shown in the drawing.

The elevator will handle wheat at the rate of six bushels a minute when operated by only a ¼-hp. motor, but it will work at a faster rate with the substitution of a larger motor unit. Its total cost to Mr. Rhodes, in addition to labor, which he supplied himself, was \$25, of which \$15 was the purchase price of the old combine.

Pointers on Servicing

GAS WATER HEATERS

By John Modroch

DERIODIC attention to your gas water heater will pay you dividends in economy, efficiency of operation, and safety. Shown in Fig. 1 are the main parts common to most types of automatic heaters.

Keep the hot water clean by draining the tank every month, as in Fig 2; this will keep heat-resisting rust from forming on the bottom and thus will be a factor in saving fuel. Keep the burner wiped free from dust and from any molature that condenses in the flue and drips down (Fig. 3).

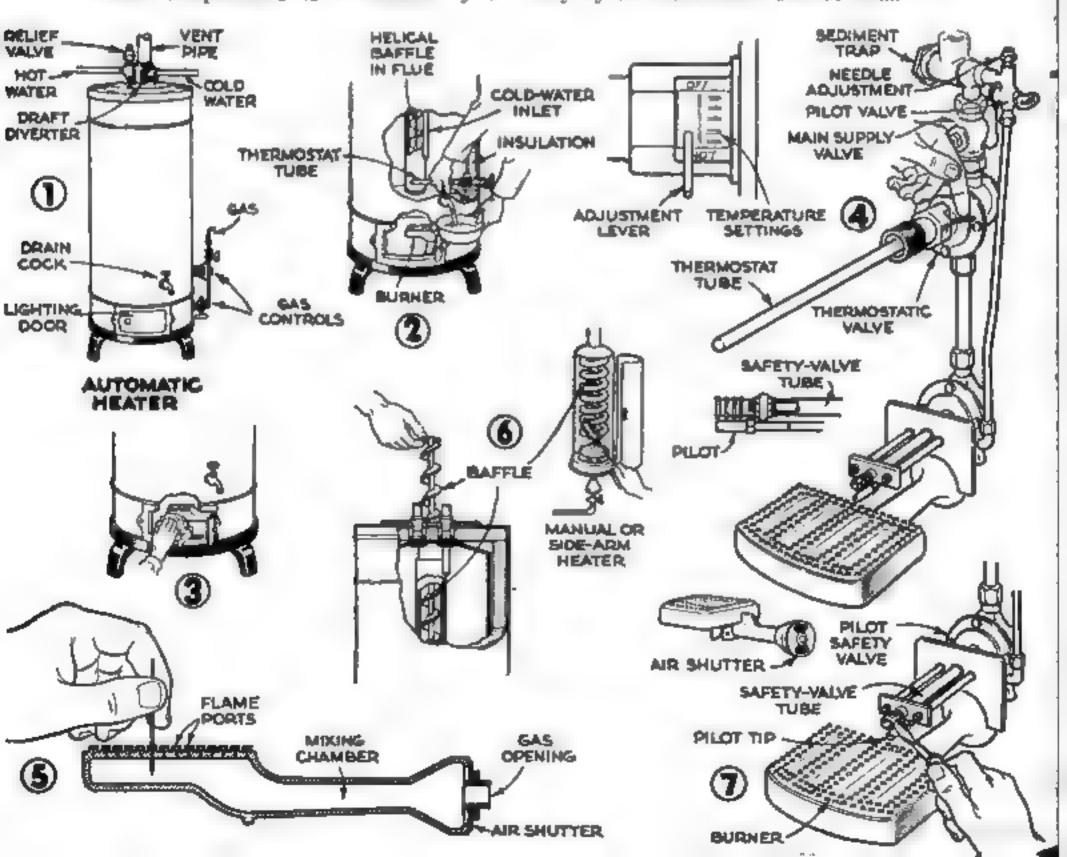
Use a darning needle to clean clogged burner jets, as shown in Fig. 5. Carbon deposited on the tips of the pilot and safety-valve tubes (Fig. 7) is likely to choke off the pilot flame and impair the safety valve. Don't let it accumulate. The flue baffle (Fig. 6) should be cleaned regularly to insure free passage for the hot gases. In an automatic heater the baffle can be lifted out for cleaning after removing the vent pipe and draft diverter. Use a brush to reach in and clean the coils of other types of heaters, as in the smaller drawing of Fig. 6.

Water temperature is controlled by a

thermostatic valve (Figs. 2 and 4) that automatically opens and closes the gas line. The valve can be adjusted by a lever, and a setting of 120 deg. is about right for average requirements. Burning continuously, the function of the pilot flame (Figs. 4 and 7) is to light the burner and to hold the pilot safety valve open by keeping its tube extended. If the pilot flame goes out, the tube contracts and closes the valve, thus cutting off the flow of gas to the burner. These safety valves are actuated mechanically or electromagnetically, depending upon the type of gas for which a burner is designed. These controls are complex, and it is advisable to call your gas company to service them,

To adjust the air supply to a burner (Fig. 5), close the shutter of the air inlet until the flame becomes yellow. Then slowly open the shutter until the flame jets turn pale blue and have very small yellow tips. The greatest heat is obtained from a quiet flame with the colors blending.

Other adjustments of gas water heaters are set at the factory and should be changed only by an experienced service man.





How to Salvage
OLD WICKER CHAIRS
with UPHOLSTERY

By HERBERT BAST

OT only a new lease on life but also more beauty than ever can be given to old wicker-work chairs that have had their withes worn loose or even torn from their frames. Regardless of the shape, style, or size of decrepit wicker furniture, upholstering will return it to an attractive and useful condition.

The old wicker chair in the photo had become so dilapidated that it had long been discarded. Its frame, however, had no broken structural parts, and a few angle irons fastened in the loose corners compensated for loss of stiffness normally supplied by the withes. All of these wickers that might hinder upholstering were then stripped from the frame. Withes that were still firm enough to add strength were left in place where convenient, as shown in one photo.

If the seat of such a chair has a

Loose or broken withes are removed from the wicker choir, and only those that will not interfere with upholstering are left, such as the ones shown. Seat springs are then retied

2 Muslin, a layer of cotton felt, and denim cover the springs, and a stuffed roll is tacked at the front edge. Burlap is stretched over back and arms, and then marked for folds







By MORTON C. WALLING

VITH simple lenses costing a few cents veach, some scrap materials, and hand tools, you can construct a compound microscope which can be valuable in workshop, laboratory, and home. Magnification may run into hundreds of diameters; but the most useful range is, in many cases, below the 100-X mark. The instrument has such features as a substage mirror, color-filter holder, aperture strip, tilting stand, and both coarse and fine-focusing provision.

Stand: The base, arm, and upright are

made of hardwood. Be sure that the dat surface at the upper end of the arm is at right angles to the notch on which the stage? will be mounted. Bore holes through the upright and arm to receive a 14"-20 bolt equipped with two washers and a wing nut or knurled knob for clamping the arm at the desired angle.

Stage: A 4" by 4" place of 4," composition board forms the stage. Two countersunk wood screws secure it to the wooden arm. Two springy metal clips are bolted to the stage for holding 1" by 3" slides.

On the underside of the stage fasten two

Critically shorp focusing of the microscope is achieved with the vernier device shown at the left and center below. The lens tube is slid within its sleeve to a rough focus, after which fine adjustment is obtained with the screw and lever action. At the right is the substage mirror mounting, consisting of a short rod hinged to the back of the mirror







parallel, grooved wooden pieces in which slide two strips cut from tin plate or cardboard. One strip has three or four holes ranging in size from about 1/16" to ½". This varies the amount of light passing through the specimen, and thus controls somewhat the contrast and sharpness of the visual image. The second strip has three holes ¾" or ¾" in diameter over which are mounted pieces of colored gelatin, cellulose film, or glass held in place with household cement. A useful assortment consists of red, blue, and green color filters, all of medium density

Mirror: Obtain a handbag mirror about 2" in diameter. Slot one end of a 14" metal rod and force into the slot one leaf of a small butt hinge. Secure the hinge with two small rivets, or by soldering, and trim off excess portions of the hinge leaf. Cement or solder the other leaf to the back of the mirror. The rod is inserted in a hole bored near the lower end of the wooden arm, allowing the mirror to be tilted in two planes for adjustment.

Leng Tube and Mountage: Any metal, plastic, fiber, or cardboard tube of about 15/16" inside diameter and 7" long may be used for the lens tube. Other diameters will do, but this one will accommodate standard eyepieces. Give the inside a coat of non-reflecting black paint.

The tube slides in a sleeve made by fastening, with very small wood screws, a band of thin sheet metal 2%," wide to a hardwood block having one surface curved to fit the tube. By adjusting the screws, you can vary the tension exerted by the band. The tube must slide for rough focusing, yet must fit snugly enough to remain in position.

Fine-Adjustment Mechanism: A metal plate riveted to the concave wooden block is held in position by two L-shaped guides screwed to the flat upper side of the wooden arm. A bent lever fits in a hole at the lower end of this plate, where it projects below the

arm. An 8-32 machine bolt passes through a hole near the other end of the lever and screws into a threaded hole through the arm. The upper end of this bolt is equipped with a knurled knob taken from an old radio. Between lever and arm, and encircling the bolt, is a stiff coil spring. When the knob is turned, the bolt head moves up or down, causing the lever, pivoting against a wood screw, to move the lens-tube block up or down. Total movement need be no more than 1 16", although greater travel will do no harm.

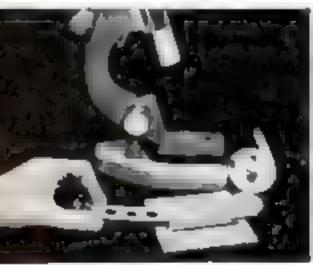
Objective Lens: The lens at the lower end of the tube, the objective, produces the initial magnification. It should be of small diameter, less than 15", and of a focal length less than 2". The shorter the focal length, the greater the magnifying power.

For your first objective, cut off a, 4," length of wooden spool. With a drill bit, enlarge the hole in the flanged end to the diameter of the lens to be mounted, for a depth about equal to the lens thickness. Paint the hole a nonreflecting black. Whittle down or build up with paper the outside spool diameter to produce a tight fit in the microscope tube. Clean the leng and place it in its recess, running a little cement or lacquer around the edge. Over the other end of the spool hole mount a diaphragm, a piece of opaque paper having a hole about 3/32" to 1/8" in diameter punched in it. This diaphragm in part governs image sharpness, so experiment with various hole sizes.

To obtain greater magnification without unduly increasing aberrations, combine two or three lenses in the objective as shown. Mount them so that their surfaces are separated about 1/16", and with about 1/16" separating the disphragm and nearest lens surface.

Eyepiece or Ocular: The Huygenian eyepiece at the upper end of the tube magnifies the image formed by the objective. It is constructed according to the following two

Aperture and color-filter strips, shown at the left, slide in slatted ways on the underside of the stage. A section of a common spool, center serves as a cell to hold the objective lens, which is comented inside its drilled recess. At the other end of the spool, below right, a paper-disk drophragm is glued on to add to the sharpness of the image





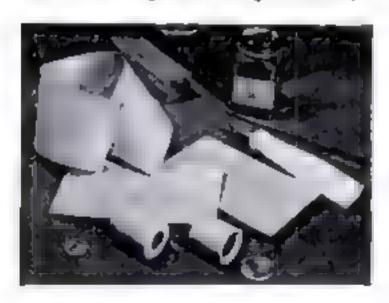


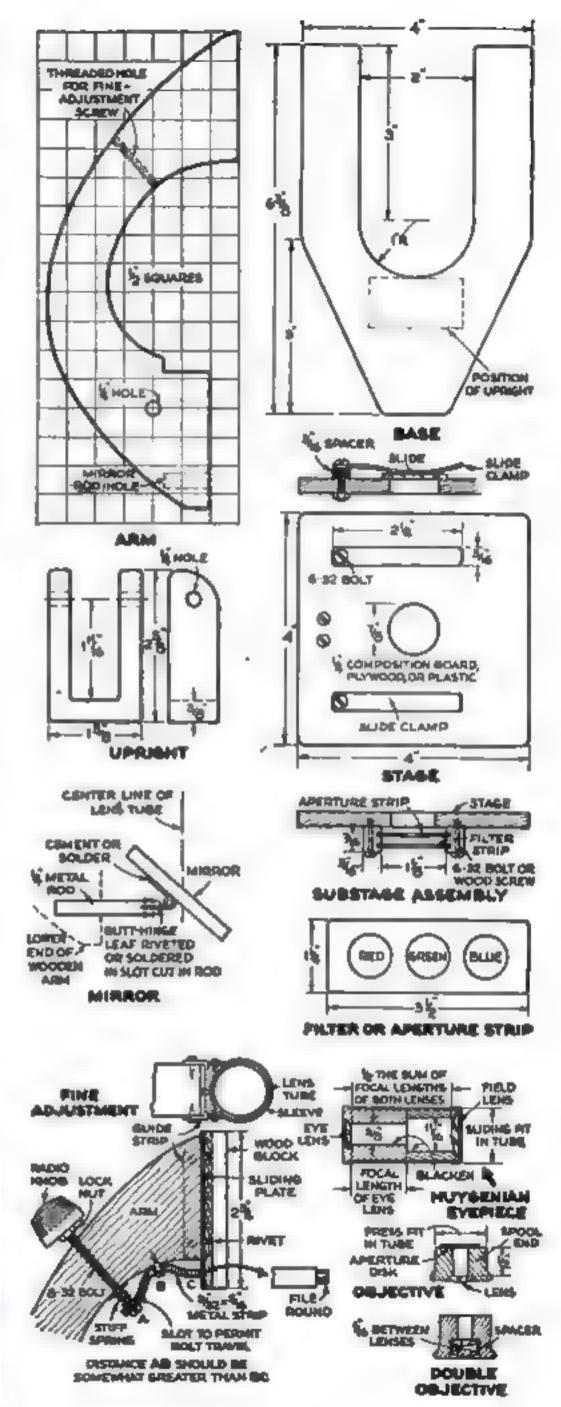
conditions: First, the focal length of the eye or upper lens should be about one third that of the field lens, the one toward the objective. Secondly, the distance between the lenses should be half their total focal lengths.

Two spools that fit easily in the tube are used to make the eyepiece. Enlarge one hole to about %" diameter, bore a recess for the eye lens, and cut the spool to the exact focal length of the eye lens. Leave the flanged portion on the lens end of the spool. Remove the flange from both ends of the second spool, enlarge its hole to almost %". and make a recess in one end for the field lens. Cut this spool so that when the two are put together, the lenses will be separated by half the sum of their focal lengths. Blacken all interior surfaces and, using gummed paper, bind the spools together end-to-end, lens recesses outward, and coment in the lenses.

Chipped-edge lenses, obtainable at low cost, are used in the microscope illustrated. The eye lens has a focal length of 26 mm, and the field lens a focal length of 68 mm., giving an eyepiece magnification of about 7 X. With a 36-mm, objective and a 7" lens tube, the total magnification is about 30 diameters. Greater magnification can be obtained by using an objective with a shorter focal length. Do not forget, however, that image clarity is reduced as magnification is increased, and that comparatively low powers are often the most revealing.

The eyepiece is composed of two lenses set in apposite ands of two speaks. The unit is held together with gummed tape

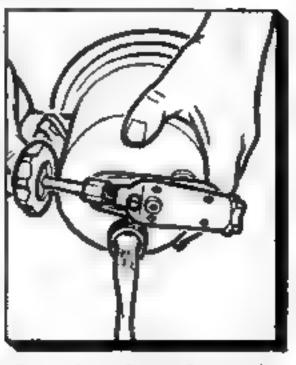




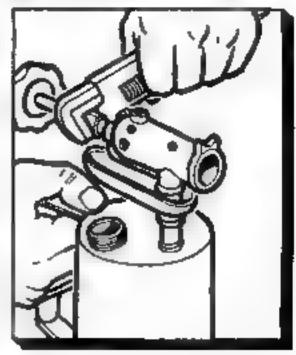
HOW TO CLEAN A BLOWTORCH



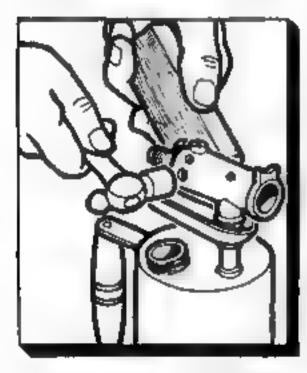
Cleaning improves operation of atorch. Checkpumpaction. Draw in oil to lubricate the leather



Empty the tank every few months and rinse out the sediment with new gas. Do this out of doors



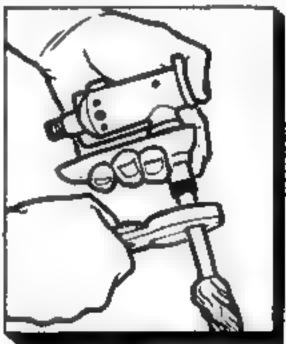
Remove the needle valve and hold the orifice to a light. A worn burner may need factory service



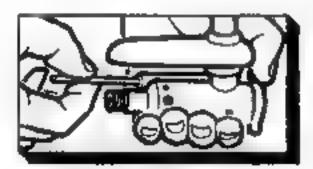
Support the burner with a black, top the cleanout plugs, and then remove them with a screwdriver



With a length of pipe inserted in the nozzle, next unscrew the burner assembly from the tank



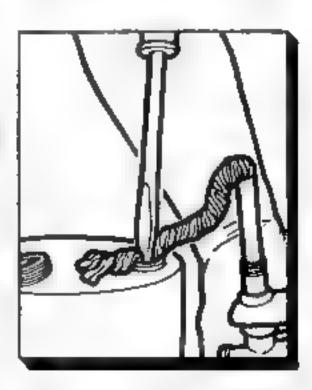
Take out the feed pipe and wick assembly, but do not attempt to unscrew the fixed burner nipple



Clean fuel passages with wire or hand-rotated drills of the right size. Never use metal to pick a needle opening; tap, as below, with wood to dislodge the carbon



Wash the burner with gasaline; then rub laundry soap into the threads of all parts to prevent leaks when they are reassembled



Twist the wick before pushing it back through the feed-pipe hole. These suggestions are taken from a Turner Brass Works publication

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Both electricity and acetylene gas are utilized to operate buoy lights. When acetyiene is used, large tanks of gas under pressures as high as 14 atmospheres are placed in special receptacles in the body of the buoy. A tiny light burns constantly, although this is invisible to the navigator. A clockwork mechanism causes gas to be fed into the burning chamber in short puffs. Here it is set off by the pilot light, the mechanism being so adjusted as to provide the predetermined quick or slow or interrupted flashes. The flame itself is small less than an inch in length, but it is magnified and concentrated by the lenses which surround it so that it shines with great brilliance over a considerable area of sea.

When electricity is used, a special mechanism in the buoy automatically replaces burnt-out bulbs. Whenever the circuit cannot be completed because of bulb failure, the device instantly makes a partial revolution, bringing a new bulb into contact.

With such devices, it is possible for buoys to remain unattended for many months—sometimes for as long as a year. In wartime, however, buoys are exposed to hazards from drifting mines, debris, and derelicts, and from the impact of ships guided by navigators in unfamiliar harbors. To meet these added hazards, the Coast Guard has had to multiply its buoy inspection and servicing trips.

It has also developed many special buoys. One of these is a can or nun buoy topped with a specially designed prismatic reflecting paper. At night this buoy cannot be seen, since it casts no light of its own. An enemy ship or submarine trying to make its way into a harbor would have to disclose its own position before it could find such a buoy. However, a ship on a legitimate mission can quickly locate these devices by sweeping the sea with even a small flashlight, for the reflecting paper picks up any light that strikes its surface.

Frequently, war conditions have required the redesigning of standard types of buoys. For instance, buoys used to support submarine nets are sometimes drawn far out of plumb by the tug of the net itself. If equipped with standard light mechanisms, such buoys would cast their light at an angle invisible from the channel. To overcome this difficulty, special tripods have been developed which hold the lights in a suitable horizontal position despite the distorted tilt of the base buoy.

Lightships and lighthouses are designed

to support a light at great height above the sea. They usually are placed at entrances to harbors, or at isolated danger points from which it is necessary to warn mariners away.

Today, most lighthouses also house fog signals—bells, whistles, or horns—and radio-beacon equipment. War has brought an end to the traditional loneliness of the light-house keeper, for now most lighthouses have augmented staffs operating the special equipment essential in wartime for detection and recognition of incoming vessels.

Lighthouse signals have their own characteristics, just as do those of buoys. Some show a continuous, steady light. Others flash at regular intervals. Still others flare up at intervals with flashes of greater brilliance than their continuous light. Sometimes an alternation of colors is used.

All these differences aid the mariner in recognizing the light which marks his landfall. Once he has identified the light, a reference to his charts will give him his position within a few yards.

The flashing lights of lighthouses are produced in several ways. In some cases the flashes result from the rotation of lenses in which various flash panels are incorporated. In large lighthouses, where electricity is the Illuminant, timing devices interrupt the flow of current or conceal the light source at definite intervals.

In minor lights, where acetylene gas is used, the fiashes are produced by interrupting the flow of gas with a bellows-like device, each small charge of gas being ignited by a constantly burning, nonluminous pilot fiame.

To service lighthouses, lightships, and buoys, the Coast Guard operates large fleets of tenders and cutters—sturdy little ships capable of carrying heavy buoys on their decks and equipped with derricks which can lift the full weight of a buoy, its long anchor chain, and its anchor. These vessels are specially designed to navigate in shallow waters and close to dangerous underwater obstructions. Their sturdy hulls can withstand battering contact with the stone or steel walls of lighthouse structures, under the roughest conditions of sea. Frequently, they must go far out to rescue buoys which have been cast free from their anchors by collision or storm. For such buoys-their lights still flashing—might serve as false beacons when once they leave their moorings and cause the wreck of the very ships they were designed to save.

seconds after being taken from the sodium nitrate solution, the rivets must be quenched in a cold-water bath. This "freezes" the copper-aluminum throughout each rivet.

Rivets made from the 17S alloy are now put in a centrifuge, a machine that whirls them at 1,800 r.p.m., driving all moisture from their surfaces. Then they are promptly placed in large refrigerators, where in a few minutes they are chilled to 10 degrees below zero F. This treatment arrests their hardening.

The 17S rivets must be driven within 30 minutes after being removed from cold storage. To insure this, the frozen rivets are packed in two-ounce cellophane bags and kept in refrigerators until they are needed. Then they are delivered in mobile refrigerators, tricycle affairs pedaled by girls, to distribution stations and handed to riveters two or three bags at a time. No riveter needs to walk more than 40 feet for his supplies.

Delivery of the rivets in the tricycle refrigerators has effected large savings at the Consolidated Vultee factory. Formerly, workers handling large numbers of rivets dropped half of them on the floor. Now scarcely one in 10 is mishandled.

Once driven, the chilled rivets harden in

the plane's structure, swelling to fill the holes into which they have been pounded. There is no danger of a riveter's mistaking a chilled rivet for an A17S rivet, which bypasses the freezer and is allowed to harden on shelves for three days at room temperature. To distinguish the two types, the A17S is dipped in yellow-green dye.

The internal structure of the rivets undergoes a radical change during the quenching, heat treatment, and aging. The polished cross section of a raw rivet viewed under a glass that magnifies it 200 diameters looks like a desert waste dotted by small shrubs casting shadows. Quenching the rivets after their heat treatment brings the grain structure into partial relief. After aging, the grains stand out sharply, like counties on a state map—or like enemy countries over which Allied bombers and fighters apread destruction with the aid of the modest rivet.—Andrew R. Boone.

Subscribers in the armed services who notify us of change of address are requested to give us the key symbols appearing on the wrapper in which the magazine is received.

Aircraft Instruments

(Continued from page 123)

mometers are used to check the temperatures of the oil, radiator coolant, cylinder heads, magnetos, and carburetor air. A "free-air" thermometer warns of the probability of icing conditions. (This, however, is not considered an engine instrument.) These temperature tellers are actuated either by vapor pressure or by electrical power.

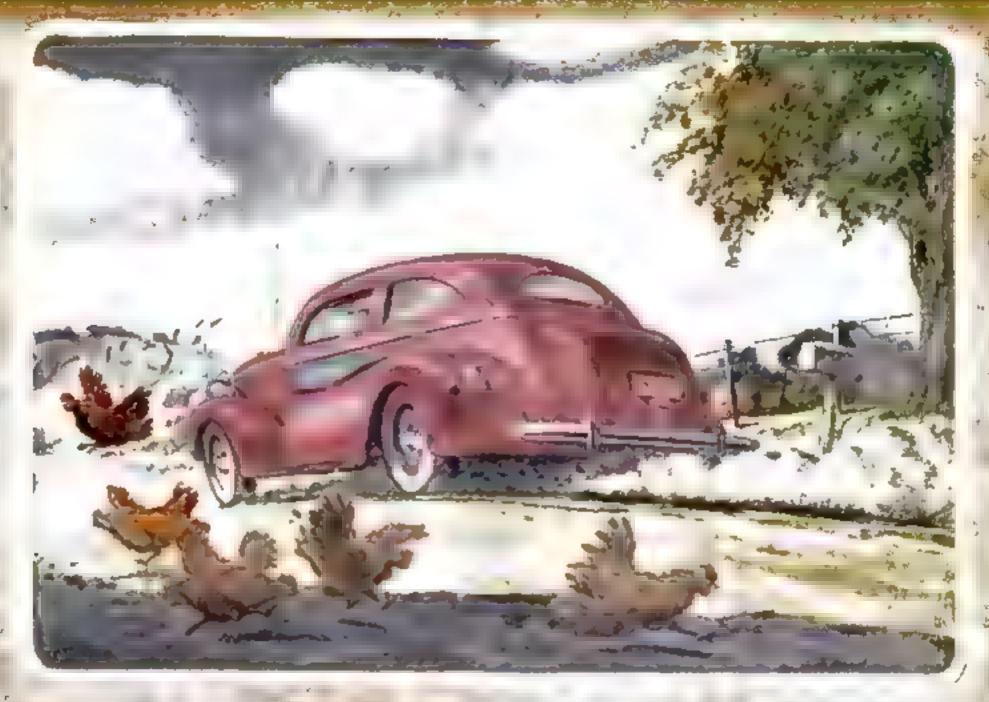
The manifold-pressure gauge and exhaust analyzer indicate the "breathing" of the engine. The former measures the pressure, or "boost," of the fuel-air mixture in the intake manifold as it comes from the supercharger. The analyzer tells the ratio of fuel to air within the cylinders by revealing the chemical composition of the exhausted gases.

The general use of radio for communication and guidance has added immeasurably to the information furnished the pilot by the instruments mentioned. The radio instruments, as well as certain avigational instruments like the drift indicator, are subjects for complete articles in themselves and cannot be included in this discussion.

The production of instruments of all kinds was once one of the most serious bottlenecks in our plane program because of problems peculiar to their manufacture, and because only a few companies manufactured instruments. This obstacle, like others, has now been overcome. We are turning them out in quantity and their performance shows that they are better than ever.

That is saying a lot. American aircraft instruments have always been the finest in the world, and the performance of our planes and pilots—civil and military—testifies to the genius of their designers both on the battle-fronts and on the home front.

Acknowledgment is given to the following manufacturers for their co-operation: Eclipse-Pioneer Division of Bendix Aviation Corporation, U.S. Gauge Co., The Lewis Engineering Co., and the Sperry Gyroscope Company.



Remember when

Jim used to average 70 - and brag about it?

CEEMS A LONG TIME, doesn't it, since Jim and chaps like him used to sit around and brag about how they made the other fellow eat their dust?

To hear them talk, a couple of hundred miles in less than a couple of hundred minutes was just ordinary going!

That sort of conversation is out of fashion now. So is that sort of driving - and for mighty good ressons.

Fast driving is plenty tough on tires-and tire wear is one of the deadliest enemies we have to face on the home front.

There's only one safe plan to follow if you own a car today: Figure that your present tires are going to have to last you for the duration (and perhaps for some time beyond)-and treat them accordingly.

There may be enough replacement tires for nonmilitary uses before the war is over. There may be synthetic tires of such quality and in such numbers that they will offset the lack of natural rubber.

But don't count on it. If you do, you may have to lay up your car. You don't want that to happen and neither does Uncle Sam, because those of us here at home must help to fight this war with our cars as well as with our sweat and our dollars. One of the major battles we are engaged in is the Battle of Rubber. You can help to win it!

REMEMBER WHEN there were new tires for sale on almost every corner, and at almost any price you wanted to pay? But then, as now, it was the INDEPENDENT tire dealer upon whom you could most surely depend for quality and fair dealing, and for interested, personal service. We at Serberling believe in the future of the American brand of independence and of the independent American business man, That's why Sesberling Tires always have been and will contimue to be sold by INDEPENDENT dealers only.

SEIBERLING Experts in

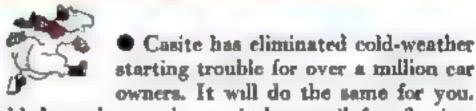




Warring manufacturers of Bullet-Scaled Tubes and Military Tires for our armed forces . Bullet-Scaling Gasoline Tanks . Rubber Floats, Boats and Pontons . Rubber Parts for Gas Masks, Airplanes and Tanks. Alsomakers of Tires and Tubes for passenger cars and trucks . Scaled Air Tubes . Rubber Heels, Soles and Mechanical Goods,



SUMMER STARTING IN WINTER WEATHER
OR



Added to the crankcase, it keeps oil free-flowing, enables motors to start faster, with less battery drain even in sub-zero weather.

Casite improves motor efficiency in other ways, too. It cleans out power-destroying, fuel-wasting sludge deposits, retards the formation of engine varnish, frees sticking valves and rings, and gives better and smoother performance all the year around.

Save your battery! Save your motor! Get Casite today from your car dealer, service station, or garage.

Remember ... CASITE GUARANTEES

That any motor capable of being started in a warm room will start in the celebrat weather when Casite is added to crankcase. Add Casite according to instructions. If your car fails to start, you get doubte your money back by filling out guarantee certificate and mailing to The Casite Carperolian, Hostings, Michigan Maximum rufund is \$1.30 per pint, which is twice not one ly advertised price of Casite.

THE CASITE CORPORATION . HASTINGS, MICHIGAN



after the take-off you have sufficient altitude to switch tanks from "Main" to "Auxiliary" with the tank-selector handle. It's smart to burn the gas in the small tanks first, so that you will have your central supply untouched until last. Also, since you know exactly the capacity of the small tanks and since they burn up relatively early in the flight, you can use them to estimate accurately fuel consumption per hour. As you switch tanks, you nose down slightly and hit the wobble pump a few times to pressure the gas from the new tank into the lines. The engine sings on beautifully. It always seems to hit better at night.

Back and forth you sweep, looking for that telltale swirl of waters marking the track of a ship. Up the coast, out to sea in a great curve, back to shore. Half an hour

Dasses.

You flip the radio switch from "ICS" to "Transmit," give it a few seconds to warm up the extra tubes, and then a call to the base radio station. You report: "Negative. Negative." (You have sighted nothing.)

The base answers with a repeat of your "Negative," and you go back to "ICS."

Time starts to crawl. A second and third radio call to base, both negative reports. Once in a while you joke with Stedman. But a joke sounds a little flat over the ICS. Meanwhile your parachute cushion has turned to concrete. The recon has become an awful bore

No sooner do you make this decision than there is a loud backfire, a rough jerk on the ship, and the engine loses power. In a flash, your left hand has found the tank selector, you've switched to "Reserve" and are pumping savagely on the wobble. The stick goes forward to pick up speed. The engine hits its pace again. Just a tank running dry!

Stedman speaks into the ICS: "I wish you wouldn't do that. It's hard on my heart.

Hard on yours, too"

Three hours pass. You are twisting and turning around the edges of several small clouds faintly outlined against a alim sliver of moon when Stedman suddenly booms from the backseat:

"A ship wake astern and to port."

Quick turn left—and there it is. The enemy. Not one wake but four zigzag white feathers being grooved across the surface of the black waters. Four warships boiling along at better than 30 knots.

The transmitter snaps on. You speak

sharply: "Emergency, Contact on four ships 20 miles out."

Base is back in an instant with the acknowledgment. Paralleling the enemy's course, you drop down close to the water to get a look at his silhouette. Your eyes search the ships as you draw closer—sweep over the fo'c'sles, up the bridges, down the stacks, on back toward the sterns. They're the same class. Make sure now, it's mighty important. Yes, they're new-type enemy destroyers.

Again into the mike: "Contact is four new-type dogs-dogs." (Four new destroyers.)

Mentally you picture the scene back at the base, the alert at Operations, defense units manning guns, the chirpy notes of CW messages to the commander of our protecting warships, the strident bong-bong of "general quarters" aboard those craft as they pick up speed and whirl to intercept the enemy.

As these thoughts spin through your head, you are giving a radio commentary on the enemy's course, speed, formation. Once, when you duck in too close, the warship at the head of the column lets fly with antiaircraft guns. You dive away swiftly, turn back parallel to the enemy when out of his range.

There'll be action shortly, for the enemy warships and our forces are closing swiftly. At that moment the base radio gives you the word you've been waiting for: "All units. Use Plan Afirm. Plan Afirm."

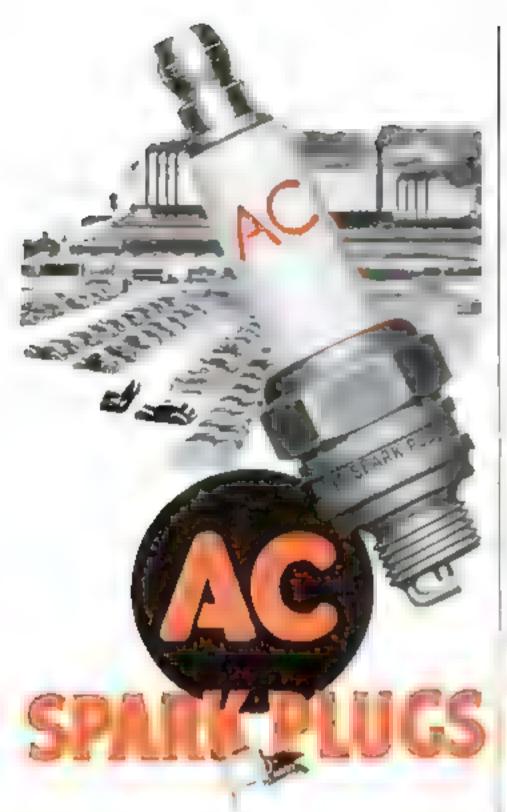
Plan Afirm is the battle plan. Your part is important and you've got to move fast to execute it properly. A full-throttle climb away from the enemy, and you turn your radio on to warm it up. Then you call to base radio to say you're in position.

A moment later comes the answer: "Strike two matches, Two matches." (Drop two flares')

A hard jerk at the flare-release knobs. A moment later, the surface of the sea is brilliantly illuminated. Plainly visible, some four miles away, are the enemy destroyers. Our forces are lost in the darkness beyond the enemy ships. Suddenly there are red-hot flashes of gunfire from that darkness. Our warships have the enemy spotted. Plainly you see the shells fall. A close straddle. More flashes. A broadside. The enemy has not fired, for he can find no target.

The enemy changes formation and course. Our forces are firing steadily now.

(Continued on page 196)



MILLIONS OF WAR WORKERS CONSERVE THEIR SPARK PLUGS BY HAVING THEM CLEANED AND ADJUSTED REGULARLY. TO BE SURE OF UTMOST RELIABILITY WHEN PLUGS MUST BE REPLACED, THEY SPECIFY NEW ACSPARK PLUGS.

Lat's ALL BACK THE ATTACK With WAR BONDS

Climb into the Cockpit!

(Continued from page 198)

The base smacks through with another call, "Strike two more matches. Two more," Out they go. Then the new flares add their light to the other flares, which by now have almost reached the water. Our warships are drawing closer now, their shells creeping up on the enemy vessels.

Suddenly there is a blinding flash from the leading destroyer in the enemy formation. The ship just erupts. A direct hit on the magazine. Your plane takes a wicked bump from the concussion. That's ail the enemy wants; the three remaining ships turn away from the action, put on speed, streak for home.

Your satisfaction over American gunnery is cut short by a call from the base; "Enemy night fighters now operating in your area." Well, if your luck will just hold a little longer you'll get home. Your relief gives you a radio call at that moment telling you to go back to the base, that he's taking over the patrol. (He's welcome to it! Good luck to him!)

Just one more hurdle—a night landing on instruments—and this recon mission will be finished. Back at the base you hit the landing circle at 1,000 feet, start a 600-foot letdown so that you will be at the down-wind end of the landing area when your altimeter shows 400 feet. You put it "in the groove."

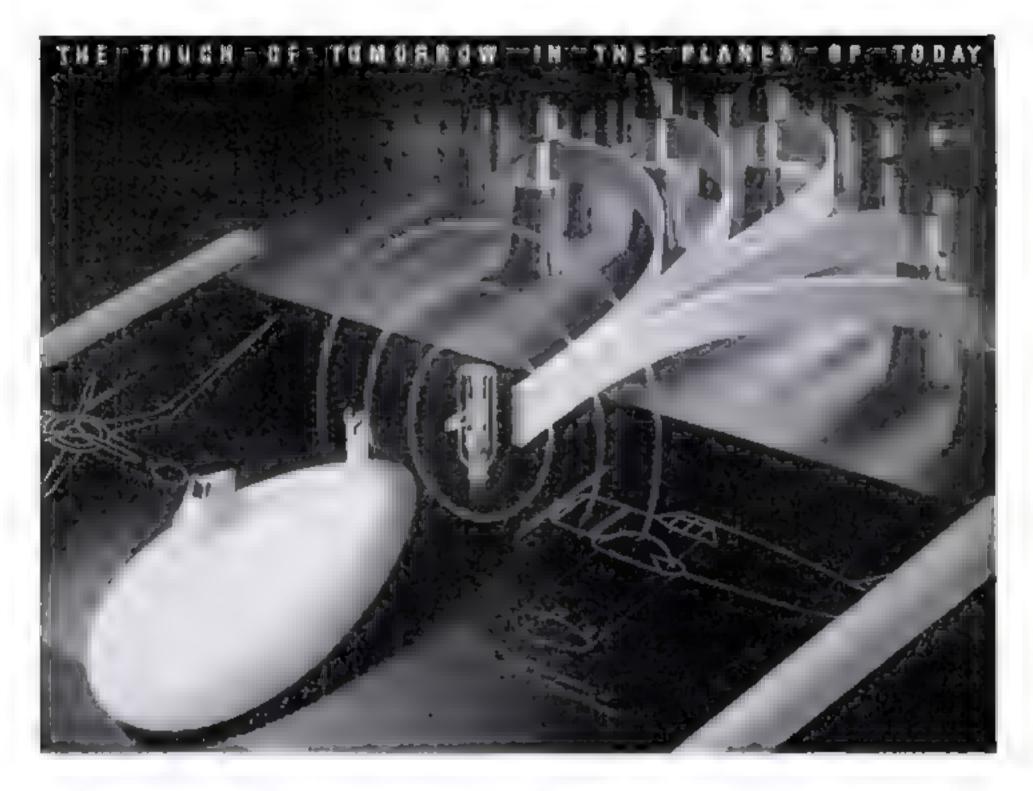
You've got to fly the little scout into the water in a landing attitude from that 400-foot altitude. Back on the throttle now, get the excess air speed killed off, full flap. Slowly the plane settles. The turn indicator is at zero (if you hit in a turn the crack-up would be a bad one), the bank bubble centered. Gently the nose comes up in a controlled stall. She's just mushing along, throttle versus stick.

With a crunch she hits. Quick, chop the throttle, back on the stick. A skid to the left. Opposite rudder. She's on the water—in one piece. A dimmed flashlight beckons from the beach. The engine noises die away as the switch is cut. The ponton grinds gently in the sand.

A voice calls from the darkness, "What's cookin' out there, fella?"

"Nothing much. Enemy task force and night fighters came pokin' around, but Sted and I scared 'em away"

Paper is a precious war material, packaging food, ammunition, weapons, and blood plasma. Save all you can to make sure these supplies reach our armed forces in perfect condition.



Warbirds Hatch Extra Range from this "Egg"

Today, the skies over targets deep inside the perimeter of Japan's island defenses know the roar of our Navy's fighters, dive bombers and torpedo planes.

Carrier-based aircraft, whose range was once comparatively limited, can now strike at the Japs hundreds of miles in advance of Navy task forces, thanks to the egg each plane carries under its belly.

To give our Navy planes this extra range, Fairchild engineers have designed a DURA-MOLDED expendable gasoline tank much lighter than its metal counterpart, but holding the same amount of fuel.

When the egg is sucked dry by the plane's hungry engine, the pilot drops it by simply pressing a button, and switches over to his ship's regular tanks.

Built entirely of plywood, it is veneered and shaped by a process known as DURA-MOLD. In this process layers of wood, laid cross-grain, are permanently glue-bonded with special resins and moulded under heat and pressure.

DURAMOLD, another milestone in the progress of American aviation, is a striking example of Fairchild's "touch of tomorrow in the planes of today."

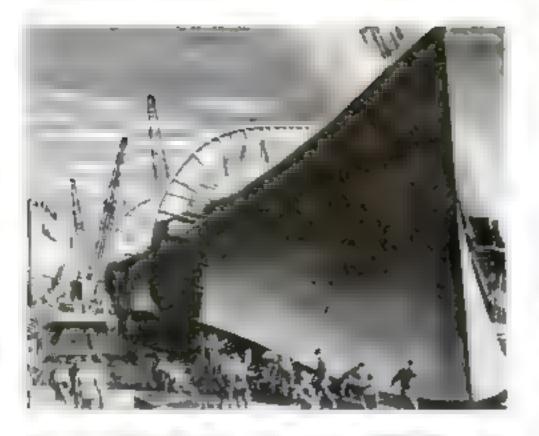
BUY U. S. WAR BONDS AND STAMPS



ENGINE AND AIRPLANE CORPORATION

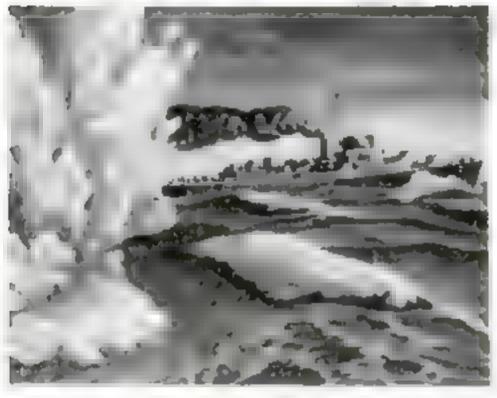
30 ROCKEFELLER PLAZA, NEW YORK

Penger Aircraft Engines Division, Farmingdale, L.L. a Fairchild Aircraft Division, Hogerstown, Md. Surlington, N. C. a Dutamold Division, New York, N. Y.



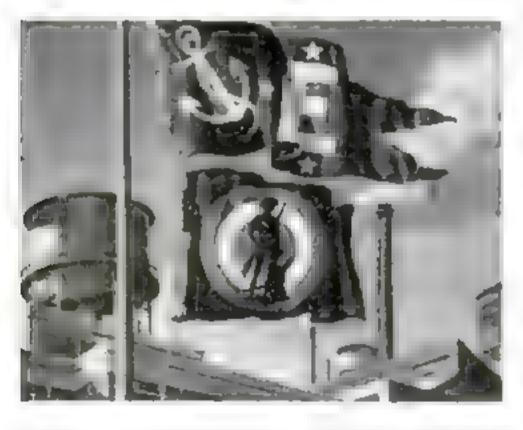
On Land!

Defoe is now building 1700-ton Navy Destroyer-Escort ships—the largest warships ever launched on the Great Lakes. Through its unique "roll-over" process, Defoe is able to deliver twice the production per man bour, resulting in double the number of ships built at half the labor cost per vessel! And all without a dollar of government financing.



On Sea!

With depth bombs, shell fire and ripping knifelike prows, hard-hitting DE ships, such as Defoe builds, are smashing U-boat packs and clearing the sea lanes for America's convoys. By releasing more and more destroyers for other combat duty, these battleworthy craft have added tremendously to the striking power of our Navy.



In The Air!

The Navy "E" with three White Star Renewal Citations flies from the Defoe flagstaff... along with the treasury department's special Bull's-eye flag awarded because Defoe employees regularly take more than 10% of their pay in War Bonds. And when Peace returns, the experience and ingenuity of this organization will play an important part in building new and better products for America.

DEFOR SHIPBUILDING COMPANY.



BAY CITY, MICHIGAN

Three White Star Renmoal Citations now decorate the Navy E' Award won by Defoe workers.

Ships for Victory
Servants for Peace



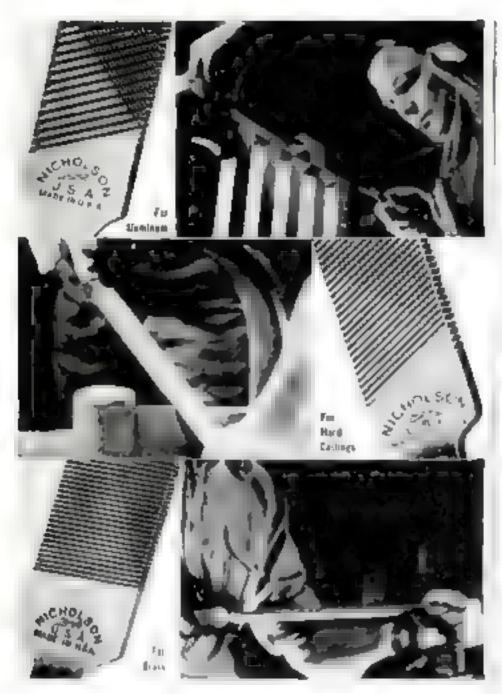


MARCH, 1944

Buy War Savings Boads and Stomps regularly.

199

BUY BONDS FOR VICTORY



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the use of files unsuited to the job in hand. Today
files and filing techniques are highly specialized.
Metals and metal-alloys differ widely. Their actions
on files vary greatly. Desired filing results are many.

The skilled mechanic must know his files—whether in operating his own shop or seeking to advance himself in industry. The right file for the job means faster production, less faulty work, greater earnings.

To the "home mechanic" with a flair for making useful things or needful repairs, there's the pride of working with an assortment of good files.

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FILES FOR EVERY PURPOSE U.S.A.

Kite That Smashed Berlin

(Continued from page 48H)

bombed. Then goes the cookie, because its momentum and concentrated weight carry it on with less angle of trail than the incendiaries.

Then the 30-pounders, and finally after several seconds the sprinkling begins, of the little fellows. A can at a time—fore, aft, starboard, port, and around again, maintaining the equilibrium of the bombing run—the four-pounders flutter down, like grass seed on the newly disturbed earth.

Multiply these thousands of incendiaries by hundreds as the planes pour over a concentrated area. A trifle difficult, doubtless, for the sand-bucket and stirrup-pump brigades.

H

The Lancs go out at sunset, one every two minutes, circle once for altitude, and are gone in the dusk—each alone, navigating on its own toward a predetermined point. It is very different with the Forts. They go out in great formations, like knights challenging to battle in the sunlight, trailing their white plumes of vapor. The Lanc is a feline huntress, who goes by stealth and stratagem, seeking only to pounce and slip away.

Of course it is not as solitary as it seems. From dozens of aerodromes the Lancs fly. precisely scheduled to the minute. The old controversy between precision bombing and area bombing is somewhat out of date, the British think, for they now do precision bombing on a district. In other days the blasting was haphazard. This squadron we are visiting has a plaque over the fireplace with a motto: "There's Always Bloody Something " Earlier in the war that meant that if you didn't find your target, you should find yourself another one, but never bring your bombs back. To young pilots today the motto is merely a soldier's gripe that there's something doing every night. If the aircraft's photographs do not show that the assigned target has been reached, pilot and navigator have some explaining to do.

The precision is attained through the Pathfinder Force, of which little may be said save that with all the modern arts of navigation it night after night penetrates Germany, outwits and misleads the defenses, and at a certain exact moment drops signal tiares on the target. If any Lanc arrives ahead of time, before the PFF, it must stooge around, killing time until the proper moment.

(Continued on page 202)

Here's how your car FEELS ...



MARFAK chassis

lubrication!

Car stiff in the joints? Hard to handle? A rattle here, a squeak there? Give it new riding comfort and driving ease with tough, long-wearing MARFAK chassis lubricant. Always applied by chart, never by chance. From king pins to rear shackles every point of lubrication is shown on the chart and the proper type of lubricant is plainly listed. And with each job your Texaco Dealer checks every point of wear, every point of adjustment, sends your car forth hale and hearty. Ask him to give your car that "MARFAK feeling"-tomorrow!





FRED ALLEN' Every Sunday night See your

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For Your Enlayment ... 2 Great Redio Programs

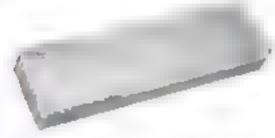
METROPOLITAN OPERA: Complete broadcasts of great operas every Saturday afternoon. See your local news paper for time and station.



KNIVES NEED HONING, TOO!



KNIVES—pocket or benchneed honing just as much as do
special purpose tools such as
planes, draw knives, chisels etc.
It's hard to get new once—so
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The best way we know to keep knives and other edged tools in tip-top shape is to use a Combination Sharpening Stone by Carborundum. One side is of coarse gut to sharpen duli tools. The other is of very fine grit to give that smooth, keen, fastworking edge that is a good workman's delight.

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Ask for No. 109 Carborundum Brand Silicon Carbide Combination Sharpening Stone, And write today to get your free copy of the booklet, "Short Cuts To Better Work For The Homecraftsman."



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THE CARBORUNDUM COMPANY

Niagara Falls, N. Y.

Christmann is a registered trade-mark of and ladienter manufacture by The Carbovardom Company

Kite That Smashed Berlin

(Continued from page 200)

But once that flare is dropped—recognizable out of all the false flares, false fires, and trickery—all hell cuts loose. Overhead comes the vast confluence of planes, whose bombing run is now identified. Still higher, above the course, streak fast aircraft dropping great parachute flares of brilliant amber light. Every 400 yards a flare, creating an illuminated path. Cones of searchlights leap up from the ground, as many as 40 or 50 to a cone. And from the stratosphere almost, behind the lights, dive fighter craft—not just night fighters but every kind the Germans possess. It is a good thing now that it is all Lancs on the bombing run, The turrets fire on everything that doesn't have four engines.

The Lance pour on in an intense concentration. In a half hour, in a path perhaps five miles wide, as many as 700 of them will pass this spot. Some of them may collide, some of them may bomb the Lance below them, but even so their safety lies in the closeness of their numbers. They fly on, straight and true, waging a battle planned with cold intellectual dependence on the law of probabilities. Some will fall, but most of them get through.

Below, there is shambles and holocaust. The cookies go in great orange blobs, and suddenly are spangled all about by constellations of white candescence. The air is pyrotechnic with cascades and showers of red and blue and green, and phalanxes of searchlights bayonet the gloom above. Through it all the Lancaster runs her steady way, while mickey mouse does its calculated chore.

You cannot see a fighter far away. It is a dim, fast shadow close at hand. Before the bomb run the Lanc can dodge him, but now she can only stab him with her stinging tail. Sometimes a fighter is a swift downward fiame, or it may be a Lancaster that fails.

Through the stench of fire, through centuries of seconds, the Lancasters follow their low bombing run. Then the cookies are gone, and the kites are up fast and away, and the conflagration fades to a dim and distant glow.

In the dark again, on the long voyage home, the Lancaster is at her best. For a few minutes she has been a tense and agile thing, but now she is quiet, gentle, and comforting. It is for this, mostly, that the Lanc men love her.

Any aircraft has a personality, and she (Continued on page 206)

LIGHTER MOMENTS with fresh Eveready Batteries

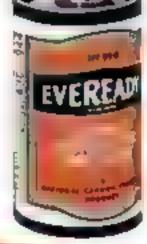


"Fax, old boy, looks as if you'll have to find yourself a manhole!"

Almost our entire production of "Eveready" flashlight batteries is going either to the armed forces or to essential war industries. So please don't blame your dealer for being out of stock.

Before you buy anything else, be sure you've bought all the War Bonds and Stamps you can afford.







The word "Eveready" is a registered trade-mark of National Carbon Company, Inc.





 Progress is inevitable. Sports have become more skillful, science more exacting, industry more efficient.

When the users of heavy-duty equipment demanded a better tapered roller bearing, Tyson introduced the "All-Rolls" design. This improved bearing, containing thirty per cent more rollers, has found wide acceptance

in transportation, industry and agriculture —wherever the going is tough.

Tyson's extra rolls mean more than greater load-capacity. They give the bearing more strength and rigidity, substantially longer life, added efficiency.

The big name in bearings today is ... TYSON!



* LET'S ALL BACK THE ATTACK *



VERTICAL CHISELING

Knowing how to use the wood chisel can save you many a piece of rare wood, and hours of lost time. Here is a point to remember:

In cutting vertically, across the grain, the chisel should be tilted slightly to one side to give it a shearing, or slicing, ac-



tion. If the surface is wider than the chisel, press part of the chisel against the portion just cut using it as a guide to cut the next portion.

Tools are Vital to Victory ... Make them last



Kite That Smashed Berlin

(Continued from page 202)

takes it from the men who fly in her. Take, for instance, that kite O-Orange, which has been going lately with the Winco on his ops among the bright lights above the German cities.

This squadron commander is a fastidious, discriminating chap, with a fluffy fresh handkerchief tucked in his left cuff, and he would never lift an eyebrow for something which was not super wizard. For years he tested Hurricanes and Spits, he has flown Halifaxes and Wimpeys and what have you, but to him O-Orange is the nicest thing yet. He needs only four more ops to finish his 50 raids, and she is going to make them with him.

(Do not think the Winco is intense. Just imagine, if you can, a man who has rolled 46 consecutive sevens, and has four more passes to make. Do not think this gentleman is cold and inattentive. He is a man with four more nights to live. But notice how he relaxes when he talks about his Lanc.)

Flying her, says the Winco, is just like dancing with your old girl. It hardly takes a touch to lead her; and, whether you're coming out of the most sudden dive or vicious vertical turn, she never tricks you at all. Mostly she waltzes, but in a pinch she can jitterbug. You can practically throw her over your shoulder, and she will not lose her poise. Once when she was caught and coned in 30 lights above the Ruhr, the flight engineer suddenly found himself sitting on her ceiling; but as she slipped back into the cover of darkness, you may be sure that none of her seven men loved her any the less for that.

O-Orange is no sweet young innocent thing. She has been to the wars. Painted on her black face are 50 yellow bombs and two small swastikas, together with three ice-cream cones which commemorate certain holiday jaunts to Genoa and Milan, during a misspent youth. But she still has a girlish, coquettish streak in her. When, on a daylight cross-country, she encounters one of those tough Yankee Forts, often she is quite unable to withstand the temptation to dive into his sights, weave for a while back and forth across his nose, and then simply to run away and leave him. You may be sure that no GI American appreciates such conduct. But that Lanc, O-Orange, with 300 m.p.h. at her command, is the kind of fast wench who (if she picks a low enough altitude) can do it, even to a Fort, and get away with it.

(Continued on page 210)



1925 Exides EXPLORE New Guiness



1914 Exides FIGRT there now . .

Exide research

keeps ahead of the need

Back in 1925, Exide Batteries first flew over steaming New Guinea. Today, Exides are fighting in the world's worst climate, ready and able to take it.

An Exide can take it in your car too, but remember, restricted driving is hard on batteries, certain precautions are necessary to keep your battery at top-notch efficiency. Starting failures can cause serious hold-ups, today.

Do your part to "Keep America Rolling" by having an experienced Exide Dealer check your battery every two weeks. In many cases, periodic recharges are essential, and with them, the Exide Dealer can put off the day when you'll

need a new battery. When you must have a battery, get a dependable, long-lasting Exide. Buy to Last—Save to Win.

THE ELECTRIC STORAGE BATTERY CO.
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EXIDES ARE USED IN MORE THAN 100 APPLICATIONS BY OUR ARMED FORCES





Little Motor with a BIG LOAD

Lashed snug.y to a pneumatic life taft, this big Navy bomb securely travels another lap on its journey to the enemy. It's capable of sinking a warship . . . blasting a strategic runway . . . or sending a munitions dump hurtling skyward. It packs a shattering thousand pounds of lethal devastation . . . but it doesn't mind being "pushed around" by a 331/2 pound outboard!

For this small Evintude, and for many other Evintudes serving the Army, Navy, Marine Corps and Coast Guard, such tasks are all in the day's work! America's amphibious operations around the globe require huge fleets of boats, and Evintudes are used to power thousands of small craft of every type. Specially developed Evinrude "Lightfours" drive huge rubber boats used in rearmament service. and for landing operations through heavy surf. Husky Evintude "Speeditwins" help build pontoon bridges, power ferries, transport troops and armored equipment. Great Evintude Storm Boat Motors drive swift assault boats at racing speed.

More than 30 years of experience, skill and engineering research are being centered on building still finer motors for our fighting forces. You can be sure that the peacetime Evinrudes to follow will be worthy successors of the fighting Evinrudes being built today!

EVINRUDE MOTORS, Milwaukee, Wisconsin



VETERAN IN SEARCH OF A PEACETIME FUTURE

THIS veteran knows of no job to come back to after the war,

It was born of war necessity - built to perform a strategic purpose new in the history of aircraft,

The requirements were extreme and infiexible. There was an "impossible" limit on size and weight. Yet some had to be ready to move as much as 75,000 pounds.

That is why even optimists doubted such devices could be built.

But here it is: The Lear Actuator.

Its job is operating flaps, landing gears, shutters and other equipment on the power of an ordinary storage bettery.

Now, of course, our plants are working round the clock to make enough of these for Uncle Sam.

But we know that such unique devices, the midget motors that drive them and all the 250 Lear products, must have an impertant future in some peacetime applica-

They may park your car with the push of a

button - or do any of thousands of jobs we haven't thought of.

That is why we are telling you about them. We want to find jobs for these able elerans.

And at the same time we want you to know that there is available the kind of engineering thinking and production technique that made them possible.

hous, Ohio and Gread Bapids, Michigan. New York, Lee Angeles, Closege, Detroit, Cloveland, Providence.

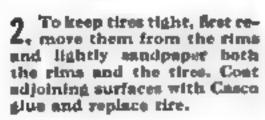


WORKSHOP WISDOM

How to keep bike tires on tight



A loose thre like this is a tiable to slip on the rim and damage the valve.





FIXING loose bike tires is only one of the hundreds of uses for Casco Glue.

This versatile adhesive is today preferred by thousands of industrial woodworkers and amateur home crafters. Here's why:

Unusual strength. Casco Glue sets chemically and hardens to form a bond of remarkable strength and toughness.

Greater durability. Highly resistant to water, heat, and age.

Fosy to mix. You don't have to heat Casco Glue. It mixes quickly with cold water.

Economical. A little Casco Glue goes a long way. Mix it as you need it. The powder, if tightly covered, lasts indefinitely.

For special outdoor jobs and water projects, experts recommend Cascamits—the completely waterproof plastic adhesive.

Cases and Caseamits come in 104, 254, and larger packages. Sold by all hardware stores.





Write for the free Casca Sluing Guide describing 80 handy gluing hints. Address

CASCO Powdered GLUE

350 Madison Avenue, New York 17, N. Y.

"Sets chemically—hardens permanently"

Kite That Smashed Berlin

(Continued from page 206,

O-Orange has had her troubles. Only a fortnight ago, coming home one night with the Winco, she was stooging around waiting for her turn to come in. She was at 1,500 feet. 14 miles from the aerodrome, when Jerry got to her. The intruder's fire cut the controls on her flaps and tabs, and knocked out three engines. The old girl staggered a bit; with her hydraulics gone she pulled and hauled. She was in a bank at 110 miles an hour, and by all the normal rules of conduct she should have gone into a helpless spin. But she pulled out of it like a glider and came in level over the treetops. One of her props wouldn't feather, and was windmilling the engine, holding her back; but the starboard inner kept her aloft. The main runway was in use, so quickly the control tower flashed the lights on another. Then in O-Orange came, dead across a brisk wind on one engine, and sat down proudly like the lady that she is.

The Wing Commander got the D. S. O. for that; but really, you know, old man, it was the old girl who should have had the bit of ribbon—O-Orange, that lovely kite.

Since this was written, there have been two bits of news. The Winco and O-Orange have safely finished their 50 ops. And that boy Roberts, from New Jersey, is reported to have bailed out safely and become a prisoner of war in Germany. Bob certainly will have a tale to tell, about himself and that kite S-Sugar, when he gets home to Merchantville.

Eggnog Fed Through Wounds Saves Russian Soldiers

EGGNOG fed through abdominal wounds is saving the lives of many soldiers on the Russian front. Heretofore the period of semistarvation occasioned by such wounds has often produced a fatal weakness. Realizing this, Soviet surgeons developed a formula rich in nourishment, which is fed through the wounded part of the abdomen at the time it is operated upon. The mixture consists of almost 13 cunces of sweet butter. two eggs, about two ounces of sugar, a little salt, and about two ounces or more of distilled alcohol. As a result of this feeding, there is much less pain following the operation, recovery is hastened, and the usual high mortality from abdominal wounds -never before below 50 percent-has been greatly reduced.



Actual photo of LEAKPEODF SATTERIES picked at random From 1939 many factors.

THESE FLASHLIGHT BATTERIES ARE

4 YEARS OLD - and STILL FRESH

Remember when you picked up a flashlight, long unused, and found the batteries dead? The fact is, most flashlight batteries die just lying around...but not Ray-O-Vac LEAKPROOF Batteries. LEAKPROOF'S patented sealed-in-steel construction seals the power in...it's there when it's needed!

RAY-O-VAC LEAKPROOF BATTERIES ARE NOW GOING 100% TO OUR ARMED FORCES

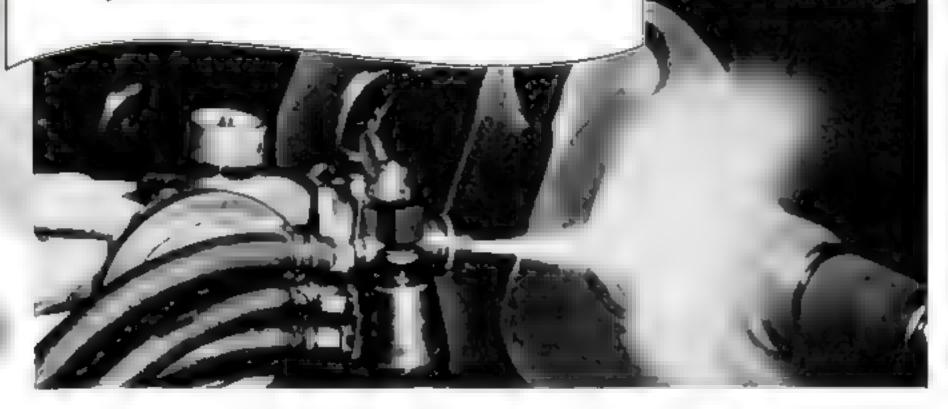




RAY-O-VAC COMPANY, MADISON 4, WISCONSIN OTHER FACTORIES AT CLINTON, MASSACHUSETTS * LANCASTER, OHIO * SIOUX CITY, LOWA

Ingenious New Technical Methods

Presented in the hope that they will prove interesting and useful to you.



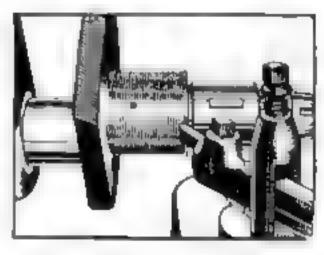
New Metal Surfaces Made by Spraying

Molton metal is now sprayed or atomized on to metal surfaces for the purpose of salvaging worn bearings, shafts, cylinder walls and such parts. Metallizing, as the process is called, is also used for putting a non-corrosive coating on iron or steel surfaces subject to corrosion such as cylinder walls of internal combustion engines, valve gates and such parts in contact with water. The metals to be sprayed may be aluminum, zinc, stainless steel, high carbon steel or other alloys depending upon the character of the surface desired. The sprayed surface may be "over built" and machined down to size to obtain accurate surfaces.

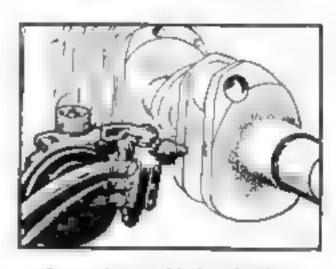
Metal spraying guns have been perfected for use with various types of gases for heat, depending upon the melting temperature of the metal to be sprayed.

We hope this has proved interesting and useful to you, just as Wrigley's Spearmint Gum is proving useful to millions of people working everywhere for Victory.

You can get complete information from The Metallizing Company of America, 1330 W Congress St., Chicago, Ill.



Rough threading—cooling lacks metal firmly to surface, producing a permenently light bond.



Sprayed journal before finishing — Main bearing journal after surface has been Metallized.

Y-104



The Atlas Lathe is one of the best known of the Atlas machines behind the guns. It's a favorite in production centers and in mobile machine shop of our armed forces. Compact, rugged, accurate, it has turned out millions of the parts that make up our tanks, ships, guns, and planes.

When Atlas Tools are again available without priorities, remember their war production record and all it means in helping us build better tools for you.

ATLAS PRESS COMPANY

355 NORTH PITCHER STREET . KALAMAZOO 13D, MICHIGAN

FOR A NEW Atlas. SHOP AFTER THE WAR

DRILL PRESSES

Keeping em Flying

WITH CHAMPION SPARK PLUGS

Themen who literally "keep 'em flying," the ground crew mechanics of the Army, Navy, Marine and Coast Guard Air Forces, are daily performing produces of maintenance, service and repairs. These unsung heroes, schooled and skilled in many crafts, keep their charges airworthy and in fighting trim at all times.

One of the first things the ground crew mechanics check is spark plugs, because they know how vital they are to the engine's performance and dependability. Outstanding performance and dependability are the principal characteristics of Champion Ceramic Aircraft Spark Plugs—qualities which have won for them an ever increasing demand from our Air Forces.

These same qualities are inherent in all Champion Spark Plugs, including those for your car. In fact, the Champions for your car are products of the same research and engineering, and many of their basic materials and patented features are embodied in Champion aircraft types.

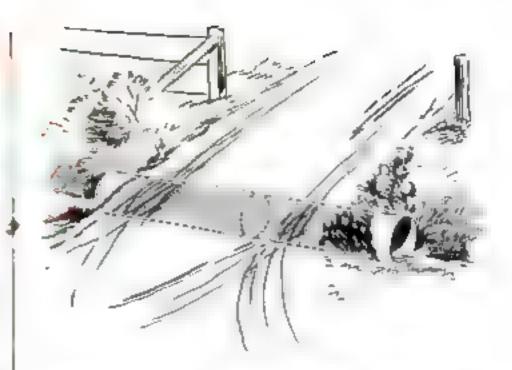
Have your spark plugs tested and cleaned at regular intervals. This is vital to the times and will assure you of maximum economy and dependability.







"... Let Freedom Ring" BUY WAR BONDS



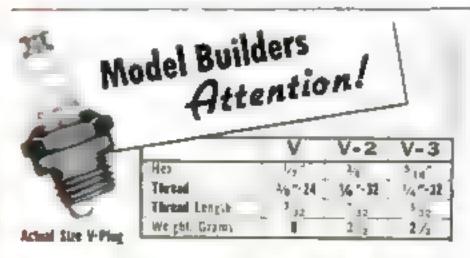
Discarded Hot-Water Tanks Form Culvert for Driveway

GALVANIZED hot-water tanks or range boilers no longer fit for service will form substantial culverts for use under walks and driveways. The ends should be cut out, preferably with an acetylene torch. A single tank 12" or 14" in diameter and about 5' long will suffice for a walk. For use under a driveway, at least two such tanks should be welded together end to end.

FUNGI attack all wood, but affect sapwood to a greater extent than heartwood. Spores of wood-destroying fungi germinate to form masses of growing threads which penetrate and decompose wood cells.

Inexpensive Diffusion Disk

PRODUCING diffusion in enlargements is casy with a piece of thin silk stretched and held firmly between a pair of embroidery hoops. Such hoops cost very little and are available in several sizes.—J. K. K.



Champion spack plugs for model gas engines give the same dependable performance as their larger counterparts. Sillment seeled. Sillmanite insulator. Alloy needlepoint electrodes for easy starting. One-piece construction.

CHAMPION

SPARK PLUG COMPANY

TOLEDO, OHIO







High on a Hilltop

You and your Indian look down on broad rivers, mighty forests, and waving fields of grain. There's nothing like an Indian Motorcycle to take you places. No other means of transportation makes you feel so much a part of the scene. Astride an Indian you're out of the monoxide line of traffic ... effortlessly and smoothly you reel off your miles of adventuring ... slip off the highways into unexplored side roads that lead close to the heart of this great land of ours ... Your Indian always responsive, easy to handle, safe. Plan to join the great

fellowship of motorcyclists when our fight for freedom is finally won. Get acquainted with your lodge dealer now.

INDIANS ON THE WARPATH

Right now, all new Indian Motorcycles go straight to war, and what a fighting record they're turning in! But new, improved, postwar Indians are already being blueprinted. They're the motorcycles to west for!



BUY WAR BONDS NOW TO BUY AN INDIAN LATER

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MOTORCYCLES

You owe it to your Uncle Sam!



The New Zenith RADIONIC HEARING AID

Accepted By American Medical Association Conncil on Physical Therapy

\$4000 READY TO WEAR

Complete—with Radionic Tubes— Crystal Microphone and Batteries
... Liberal Guarantee He needs manpower—every available person. A bearing deficiency may keep you out of the around forces..., but you can do your fighting on the home front... in war material plants. A good bearing and enables you to go all out in the war offert. The movement is growing. In our plant today are workers wearing hearing aids and contributing as competently as if their hearing were normal.

You owe it to your friends!

They want to enjoy your company as much as you do theirs. Your bearing aid means as much to them as it does to you.

Are you really doing your part?

That question only you can answer. Think!

Report on a Revolution

Zenith recently started a revolution—to reduce the rest of hearing. After years of research and preparation, the Zenith Radionic Hearing Aid is now offered to the public

The price—340—(about one-quarter that of other good vacuum tube instruments). Complete—ready to wear—with miniature radio tubes, crystal microphone and batteries liberally guaranteed.

Inquiries from everywhere have flooded the mails—telephone calls—telegrams

A sales volume—unheard-of in this field—is gaining daily momentum—and is a demand created by self-evident ment of the instrument itself. Today our problem becomes one of production and distribution—to as quickly as possible make the Zenith Radionic Hearing Aid available in all localities.

We are doing our best to furnish additional manpower for UncleSam's production forces. And—in the doing—we are experiencing that rare satisfaction born of directly contributing to the welfare of individuals

THE ZENITH HEARING AID WILL BE AVAILABLE THROUGH REPU-TABLE OPTICAL ESTABLISHMENTS PRANCHISED BY ZENITH (NO HOME CALLS OR SOLICITATIONS)

Write as for address of ontist avairables year.

Zenith has built the best that modern knowledge and radionic engineering make possible into this \$40.00 hearing aid. It has no other models . . . one model . . . one price . . . one quality.

There are cases in which deficient hearing is caused by a progressive disease and any heating aid may do harm by giving a false sense of security. Therefore, we recommend that you consult your orologist or ear doctor to make sure that your heating deficiency is the type that can be benefited by the use of a heating aid.

TO PHYSICIANS

A detailed scientific description will be sent upon request. Further technical details will appear in medical journals.

Wrate for Free Description Booklet
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ZENITH RADIO CORPORATION
CHICAGO 39, ILLINOIS





it's You . . . and the Rest of the Team

Your big Liberator is coming in fast now buring head on through black burses of fink that rock her like a canon, From your grandstand seat in the greenhouse, you can see fires down below. That's where the first wave laid its eggs. You're next

Sometimes, back at "pre-flight", it didn't quite add up. Lagarithms . . . formulas . . . classes all day. You couldn't see how you'd ever use the stuff they crammed into your head. But you stuck it out. You wanted Bomburdier's wings.

The top-turret guns begin to spit, as you hunch down over your bombsight. Check for altitude! Check for air-speed! The guns are going faster now, but you won't let yourself look up. (heck for wind-drift! Suddenly you realize you re doing things automatically , , all the things that came so hard in training. And you're doing them right!

In advanced school you got pretty cocky. Pilots? Navigators? O. K. for some guys maybe. But you're themanthey build bombers around! You pack the knock-out punch!

The Lib heels, and straightens out on her target, and Pete comes in over the interphone: "O. K. Slugger. She's yours. Make it good!" You're the boss now. This is what you've been watting for. You give your eye to the right, and talk Pete ... bold that level. Bomb-bay doors open, Left a little . . . level now . . . level . . . perfect!" And there's your targetcaught in the cross-hairs like a fly in a spider web.

You jab the release. "Bombs Away!"

Now you've done it! The seconds drug out . . . and then Beery, back at the tail-gun, yelly "HIT-HIT-HIT-HIT" On target!! Hey, Lieutenant. Come and get

Well . . . ! Your chest starts to swell . . . and then all at once you see that it wasn't just you who smeared that Nazi base. It was Pete, up in the pilot's seat . . . Cliff, with his navigation charts . . , the gunners, Jim. Tony, Beezy, Lou. It was you ... and the rest of the crew ... flying as a team . . .

The same kind of team that paved the way for the landings in the Gilberts . . . that cleaned up the Japs on Kiska . . . that flattened Bremen and Wilhelmshaven . . . that is carrying the war to Japan . . .

The A A.P. . . the greatest team in the world?

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MEN OF 17...

You can get ready now for your placeas Bombardier, Navigator or Pilot-on this great A.A.F. team. Go to the nearest Aviation Cadet Examining Board . . . see if you can qualify for the Air Corps En-lasted Reserve. If you qualify, you will

receive Enlisted Reserve incalled for training until you are IS or over.

When called, you'll be given 5 months training fatter a brief conditioning period) in one of Americontrol flying instruction , . . then go on to eight months of full flight training ... the kind of training that makes America's filers the world's best! When you grad-uste as a Bombardier, Navigator or Pilot -you will receive a \$250 uniform allowsace and your pay will be \$246 to \$327 per month.

Meanwhile, see your local Civil Air Patrol Officers about C.A.P. Cades training ... also your High School principal or adviser about recommended courses in the Air Service Division of the H. S. Victory Corps. Both afford valuable pre-BVISHOR BESIDING.

(Exsented workers in War Industry or Agriculture do not apply ,

For information reporting Naval Amortist Codes Transcorp, appear at the Rivert Accurison Codel Selection. Board to any office of Naval Officer Procutement of at any Nary Bosen teny Station, or of you are in the Name Maribe Corps or Could Guard apply through your remmanding affect. This ad-

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certisement, has the approval of the Joint Arms Nury Personne Board,



MARCH, 1944

Buy War Savings Bonds and Stamps regularly,

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Prevent those Heatless huddles



STEP UP YOUR COMFORT WITH BALSAM-WOOL ATTIC INSULATION



Even though fuel must be saved, you don't need to sacrifice comfort! Balsam-Wool Insulation—applied in your attic—will keep your home warmer — more comfortable—with fuel savings up to 20%. It's the sensible, patriotic way to cooperate with the government fuel conservation program!

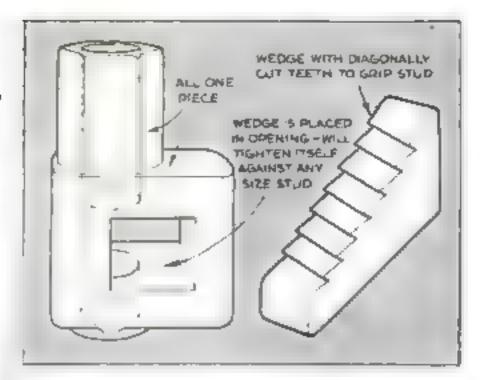
Balsam-Wool is the famous, original blanket-type insulation . . . an insulation that has proved its latting efficiency in hundreds of thousands of homes. That is why it is offered under a money-back guarantee of complete satisfaction. And remember, Balsam-Wool is easily applied—laid like a carpet in your attic. Windproof, moistureproof and fire resistant, it has corrything an insulation needs.

See your lumber dealer—now—about applying Balsam-Wool, and ask him about a monthly payment plan. Or, mail the coupon for complete information.

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Stud Remover Made from Steel Block and Toothed Wedge

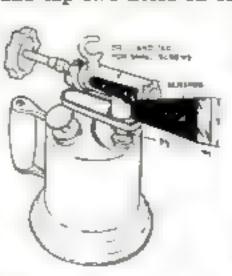
To MAKE this handy tool, cut enough stock away from a block of steel to form a hexagonal head at the top. At the bottom, cut back a 1/16" relief everywhere but directly under the nut. Drill a hole through this portion of the body, as indicated by dotted lines on the sketch above, to accommodate the largest size stud to be removed. The device also works on smaller sizes,

Next, mill a rectangular hole through the side of the block so that the inner edge will bisect the drilled hole. Cut a triangular wedge to slip easily into the milled hole. After cutting several diagonal teeth in that portion of the wedge which will contact the stud, harden and temper it.

To remove a stud, slip the body of the tool over it and insert the wedge. Apply a wrench to the hexagonal head. The more force is applied, the tighter the wedge grips the stud.—E. S. HARRIS.

Paint-Scraping Attachment

SOFTENING old paint with a blowtorch and then acraping it is the most effective means of removing it before a repainting job is done. The drawing below shows a small scraper attached to the blowtorch so that the work can be done with one tool. Drill and tap two holes on one side of the burner



for small screws to hold the scraper in place. This is of \%" flat steel, with a blade 2" wide at the end and 3\\%" long. Before the scraper is attached to the blowtorch, the end should be carefully sharpened, as shown.—H.S.

WHY THE



ONE REASON YOU CAN'T BUY THEM NOW

This is the drive cog of a tank. It yanks the tread with as much as 1,000 horsepower. That, together with rough going, gives tank treads an awful besting. So, for security, they are fastened with Elastic Stop Nuts. The cog and each lug you see in the picture are held on with Elastic Stop Nuts.

You see here an Elastic Stop Nut.

The thing that makes it different from other nuts is the special collar in the top.

This collar is made of an clustic material.

It presses itself between the bolt threads. It grips and holds tight. The nut cannot turn by itself.

This means the nut locks anywhere on the bolt and won't work loose.

Even violent vibration won't budge it.

You can put an Elastic Stop Nut on and take it off, time and tune again. It always locks.

That's because the collar is clastic. It does its job and comes back for more.

Many billions of Elastic Stop Nuts are in use.

And to our knowledge, not one in a million has ever failed.

When peace comes, Elastic Stop Nuts will be available for all the good things to come. They will make them safer, stronger, more dependable and free from frequent servicing. So expect to see many of these nuts you can identify by ESNA'S red collar.

ESNA

STASTIC STOP NUT COMPOSATION OF AMERICA

ELASTIC STOP NUTS

Lock fast to make things last

Union, New Jersey and Lincoln, Nebraska

There is No Substitute for Experience

Of all the valuable components of Johnson Sea-Horse outboard motors (now being made exclusively for war and essential needs) the most priceless is experience—long experience in outboard development, metals, manufacture, service. This is an extra element that goes into every Sea-Horse motor built, JOHNSON MOTORS, WAUKEGAN, ILL.





The tremendous holding power of Weldwood Glue is due to the strength of the band it makes between woods. It actually toolds them together.

DO YOUR DUT

BUY WAR BONDS

You'll find Weldwood Glue remarkably simple to mix and use, too Just mix the fine powder with ordinary tap water, spread with brush or stick, and the job's done. Clamps can be removed and the job can be light-worked in a few hours

Your hardware store or lumber dealer has handy packages of Weldwood Glue in 10c, 25c, 50c and 85c (1 lb.) sizes. Get a can today or send 25c and your dealer's name for a trial 3½ oz. sample Supply limited, due to Uncle Sam's war needs.

UNITED STATES PLYWOOD CORPORATION

Weldwood Olus Dept 25, 55 West 44th St., New York 13, N.Y.

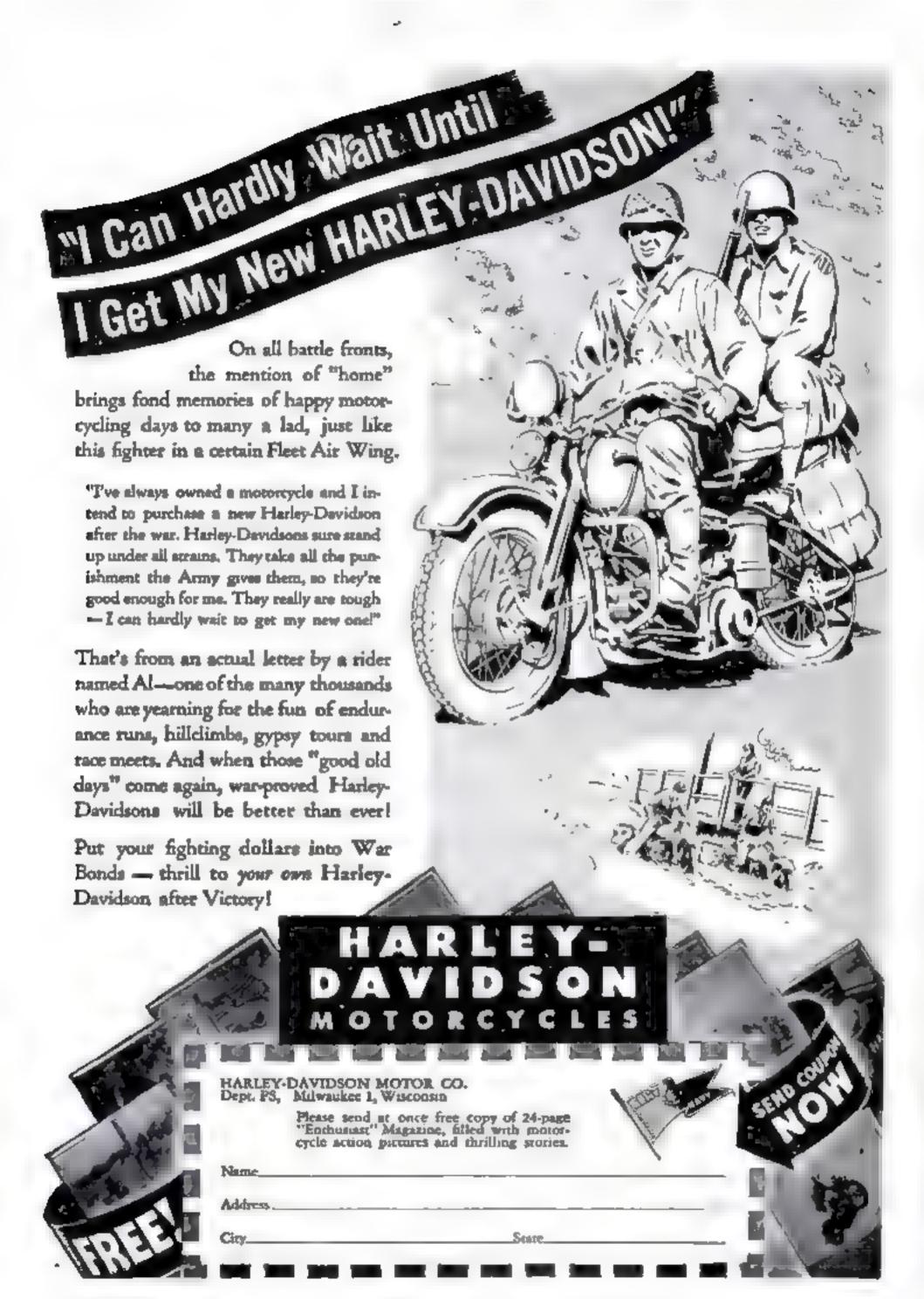
Weldwood Glue has everything:

- 1. Tremendous strength
- Waterproof, bacteriaand rot-proof.
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- 4. Economical.
- 5. Applied cold, quick petting.
- 6. Smin-free.



"Makes the glue line the SAFETY line"





Home Craftsmen



Our Government is asking everyone to conserve tools. That's why many types of tools are sold now by your Hardware Dealer for essential wartime are only.

But if you cannot get a new hand saw, quite likely you saw have your old one reconditioned. If your saw is a Disston—or other quality make—a good, inexpensive sharpening and repair job now will put it in serviceable condition.

The man to see is your Disston Hardware Dealer. He can advise you about putting your present saws in order—tell you what tools are available for your home workshop—and discuss the possibility of securing new tools for estimated service.

You are serving both your country and yourself when you make the most of your present equipment... See the Disston dealer near you about reconditioning your old saw...Help save new tools for vital war work.

 YOU CAN LEARN A LOT about tool use and care with the Disston Saw, Tool and File Manual—FREE from your Hardware Dealer, or write for a copy.



HENRY DISSTON & SONS, INC. 310 Tacony, Philadelphia 35, Pa., U. S. A.



Crutch Tip on Faucet Speeds Washing of Photo Prints

The tediousness of washing prints in a lavatory bowl, and the need for separating them by hand, can be eliminated by the use of a rubber crutch tip. A small hole is drilled through the lower portion of the tip at such an angle that when the tip is forced over the end of the faucet, a jet of water will play along the side of the bowl. This creates a swirl of water in the bowl that keeps all the prints separated and at the same time does a thorough and efficient job of washing them.—E. L.

Mixing and using concrete is easy if a few facts are understood. An average mix is I part cement, 2 parts sharp sand, and 3 parts coarse gravel. Mix well; then wet just enough to make a stiff mixture. Never pour concrete in very cold weather; if, on the other hand, the sun is hot, cover the job for several days with wet burlap bags to let it cure slowly. Good concrete makes permanent repairs.

Preventing Eraser Smudges

RUBBER crasers that have a tendency to smudge the paper when used on pencil marks can be given a simple treatment that helps to eliminate the trouble. Make about



six knife cuts in the ends of the eraser. These pick up particles that would otherwise be ground into the paper.—T. E. G. TO THE WORLD...

they gave the mir-

acle of Radium...

TO EACH OTHER ...

they gave a wonder-

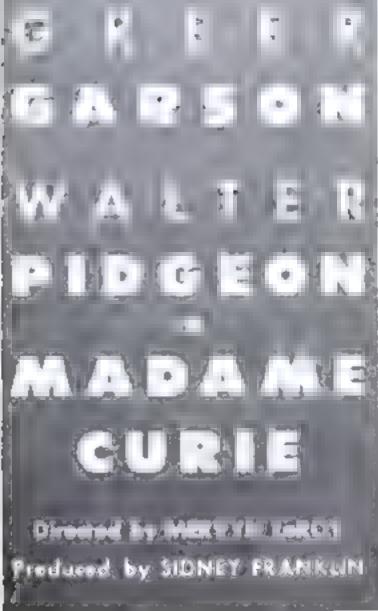
ful love.

TO YOU...

memorable motion

M-G-M

presents





A METRO-GOLDWYN-MAYER PICTURE

with a brilliant supporting cast + Henry Travers

Robert Walker + Dame May Whitty - Elsa Basserman

Van Johnson + Albert Basserman + C. Aubrey Smith

Victor Francen + Reginald Owen + Margaret O'Brien

Screen Play by Paul Osborn and Paul H Rameau Based on the book, "Madama Curie" by Eve Curie



You have unjoyed such good service and long life from your AC Fuel Pump because of the quality that is built in, from design to finished pump.

You will continue that performance and quality if you insist on an AC when you need a new, or a rebuilt, fuel pump.



BUY WAR BONDS . BRING VICTORY QUICKER



Shinola **Colored Waxes** in all colors

 Whether you want to cover up algorette burns, nicks, scratches on new furniture ... or bring back the rich, meltow finish on an old piece of furniture, there's a Shinola wax to match wood of any age or color. These first-aid-for-furniture waxes, in the handy shoe polish tins, are easy to apply . . . economical to buy.

The scientific combination of ally waxes in Shinola provides a protective pliable film which helps repel water, dust and grime. Applied and finished like any other wax, Shinota waxes buff to a quick, brilliant shine. Swell for

leather and linoisum, too... Shinola is the largest self-Ing poste polish in America.

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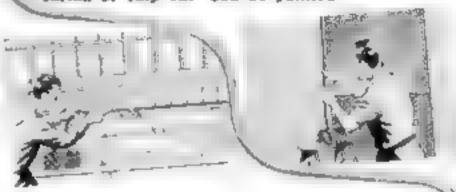
HINOLP

KEEP 'EM SHINING WITH

Wartime places heavy demands on our supplies, so If your dealer is temporars ly out of stock, please be parient.

IN ALL COLORS: TAN - BROWN - OX-BLOOD - BLACK

A pliable plastic that comes all ready for use inside or outside. Uprolls like ribbon. Adheres to any clean, dry surface. Just press into holes and cracks with the fingers and it stays put. Will not crack, shrink or chip off. Can be painted



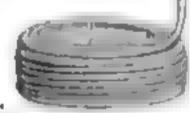
- A good plugger-upper · Seals cracks in plaster and woodwork, ground ments, transoms, base-
- boards · Keeps out dirt, dust and vermin. Stope rattles
- · Permanent glasing for wood or metal sauh
- Plugs leaks around bathtubs, toilets, sinks, laundry tube, etc.
 - Makes good packing and gaskets

About 80 feet of 14" Mortite to a cell. At your dealer's, or \$1.25 postpaid.

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COUNT TELEGRAPH WIRES IN THE DISTANCE





This 8 power telescope makes objects 200 yards away appear as 100 yards d stant, Brings objects 9 Limes closer Telescope closed is less than 1 ft. Spot planes, ships, people, sporting events, etc. Has large 50 inm lens (2 inches in diameter) something thusly found only in higher priced telescopes 20 DAY PREF, TRIAL Try for 30 days at our risk! Return if not completely satisfied SEND NO MONEY Just pay posimen \$2.99 plus few cents posinge Cash orders sent posipaid Don't wall—production of telescopes may be curtailed as it has been on binoculars. Vague Telescope Co., 7753 S. Haisted, Dept. K-106, Chicago to.

GUNS &

Are you a collector? A game and rumpus room decorator? Your treasure bunt ends in our catalog listing over 1000 authentic items including old pistols, swords knives, armor, etc. To get your 100-page librairated catalog send 25c to OA PB, DIE LEXIATION ATE., NOW I CIL II, N. I





For eighty years, Stevens has pioneered new and better guns and new and better ways to

Whatever the sport ... snapshooting at rabbits streaking over the snow - swinging on upland game birds bursting from cover - - bringing the gun up fast on mallards or honkers zooming in overhead - - - - holding steady on a varmint sitting, alert near his burrow for hunting, target shooting, or just plain "plinking," Stevens built finer rifles and shotguns to bring the shooter more pleas-

Three examples of Stevens' ploneering development are illustrated. These models were brought out just before the war required Stevens to devote its large capacity and precision facilities to the manufacture of huge

As to the future - look for more Stevens improvements . . . new models . . . finer Stevens

At Stevens, the pioneering spirit lives on.

J. STEVENS ARMS COMPANY . Division of Savage Arms Corporation . Chicopee Falls, Mass.







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You'll get a big kick out of the meanings of people's names in "WHAT'S IN A NAME?" We'd like to send you this booklet free because we think it will help you remember what our name means:

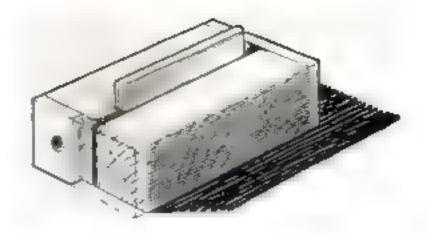
"ETHYL is a trade mark name. It stands for antiknock fluid made only by the Ethyl Corporation."

Send coupon for free booklet. It gives meanings of over 900 names.



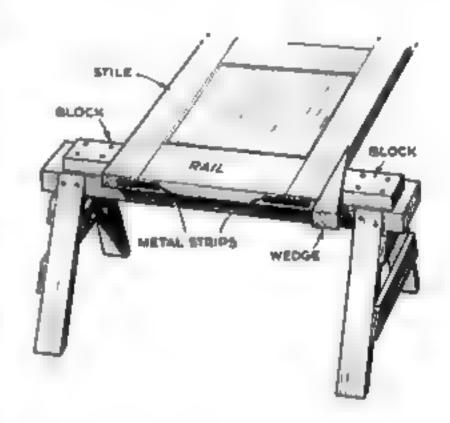
"WHAT'S IN A NAME?" Dept. H10, Box 53, New York 8, N. Y. Please send me a free copy of "What's in a Name?"			
Name (PLEASE PRINT)			
Address			
City & State			





Blade Holder for Draftsmen

A SAFE holder for a razor blade to be kept on the drafting board or workbench can be made in a few minutes. Two pieces of soft wood about %" square and 2" long across the grain are carefully sanded, then joined by two thin pieces of wood to form a narrow groove that will hold the blade upright, as shown.—B. B.



Wedges Force Joints Together in Repairing Damaged Door

THE glued joints of doors that are exposed to the weather for some time often open up, especially between the top and bottom rails and the stiles. A simple and effective method of forcing the joints together is to lay the door flat on a pair of sawhorses. Nail a square block on each sawhorse so that one edge of the door is butted against these blocks. On the opposite end of each sawhorse nail a block with one edge cut diagonally.

Drive wooden wedges between these blocks and the door stile to force the joints tightly together. Set flat strips of Iron into recesses gouged out to fit them. Fasten these with long, flathead screws countersunk flush with the edge of the door.—A. L. K.



Fascinating Delta Book -points the way to fun and

-points the way to tun and healthful recreation in your

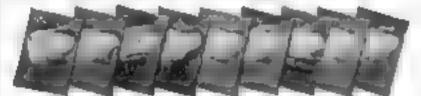
Homecraft Shop



Fifty-six pages of practical, detailed help — ideas, pic-tures, plans, dia-grams — in:

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Whether you are a veteran craftsman or a beginner, there is priceless information for you in it's De ta book. Specific information on buriding shap benches, tool racks cab nets, etc., chapters on Type of Shep, Wiring, Shop Lighting, P. wer Tools, Choice of Hand Tools, Paint Rack, Shop Pictures and Layouts, and many others. All this for only.



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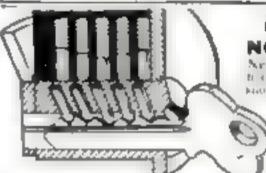


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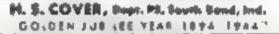
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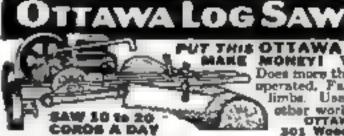


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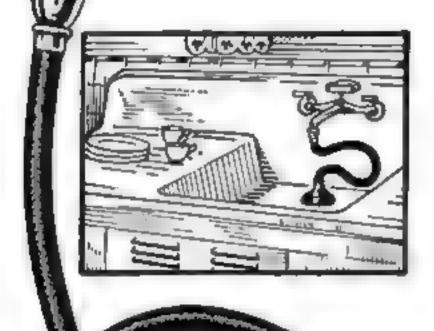


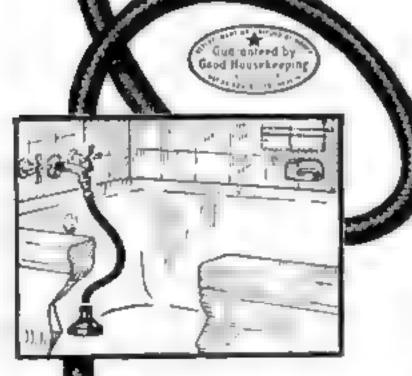
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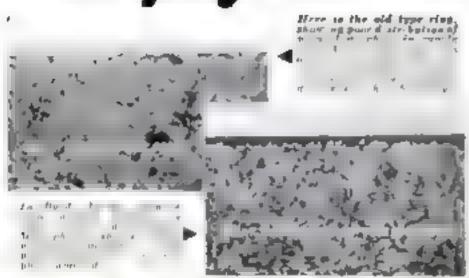
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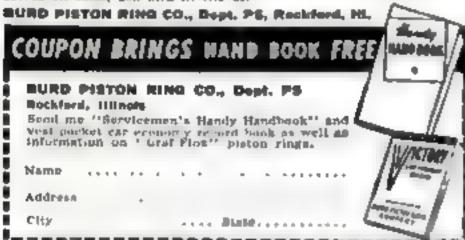


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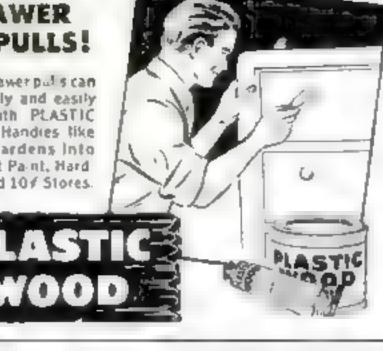
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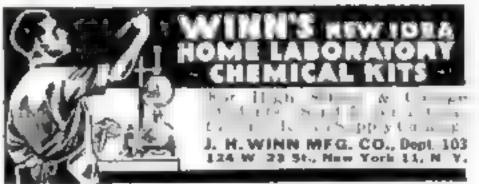
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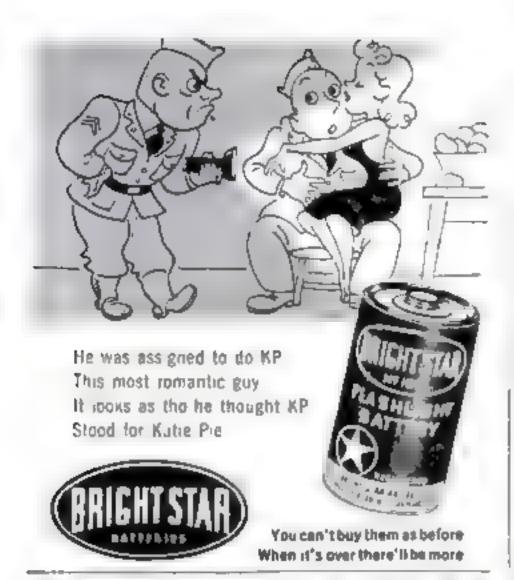
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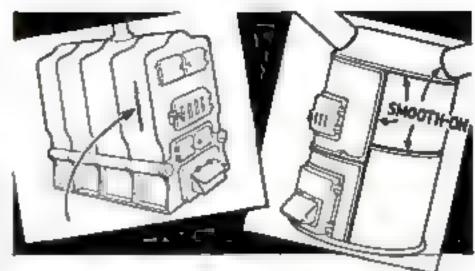
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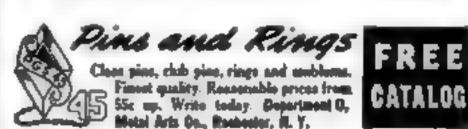
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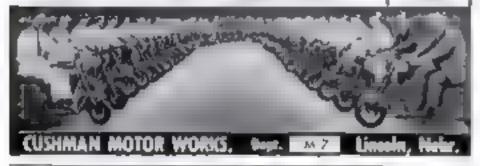
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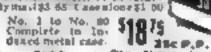
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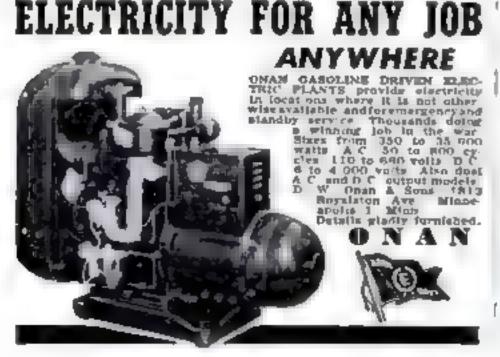
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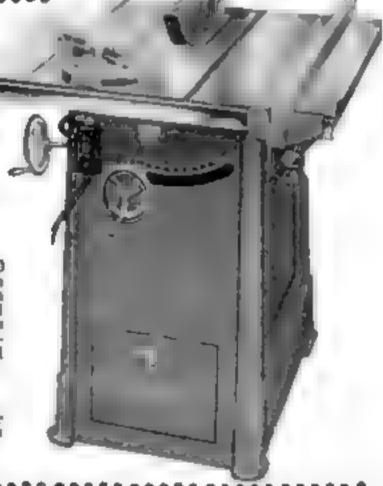
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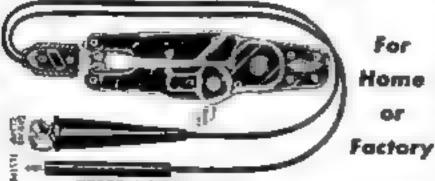
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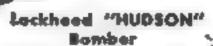
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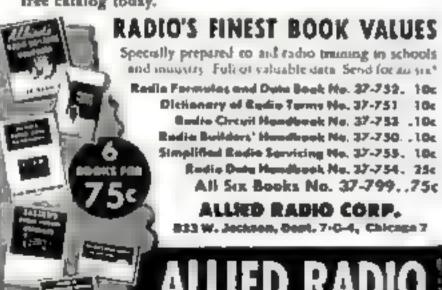
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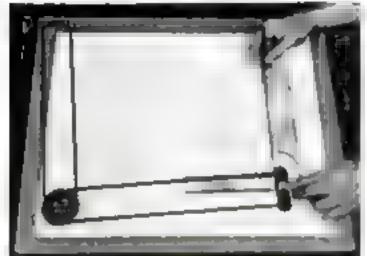


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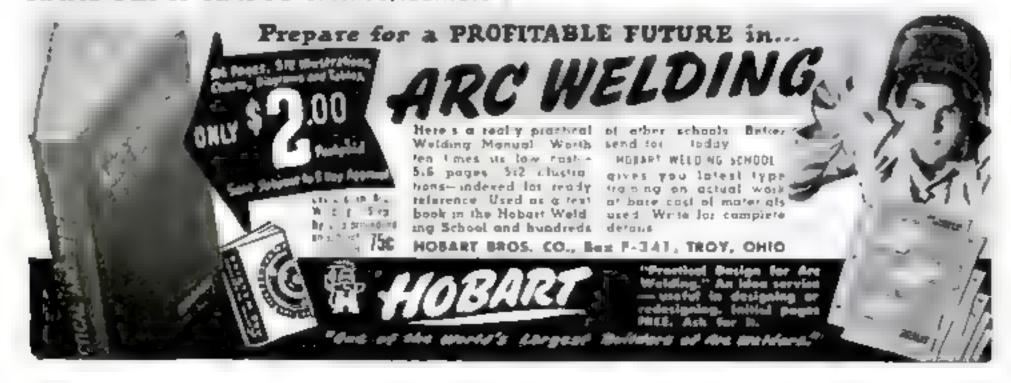
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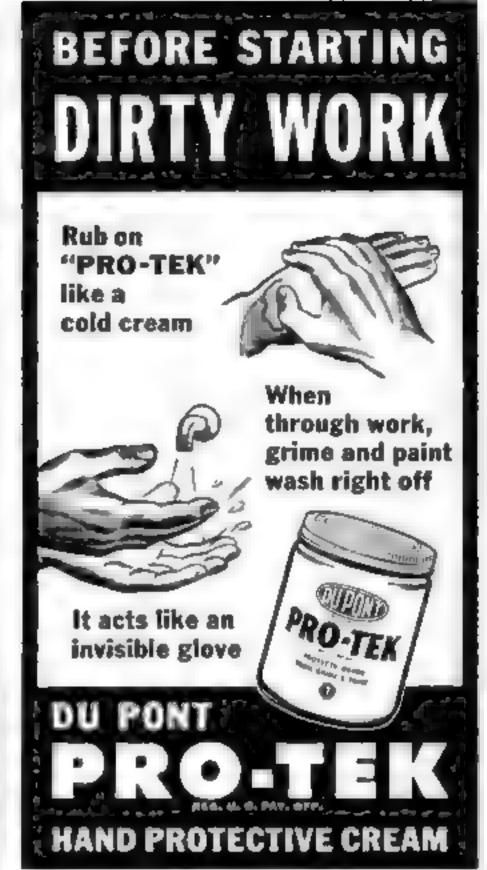
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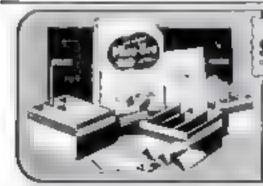
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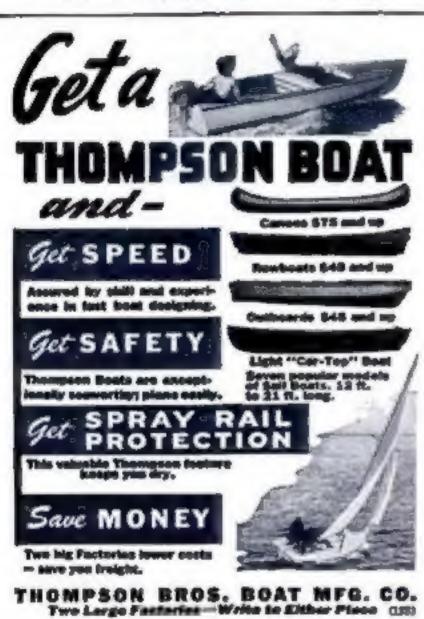
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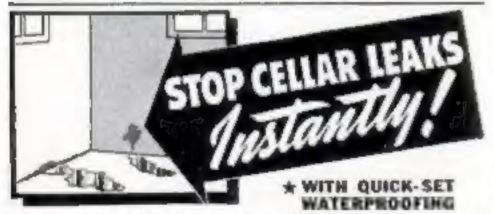






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